TAYSIDE ECONOMY: AN INPUT-OUTPUT APPROACH TO ANALYSIS AND PLANNING

by

Thilaka Sarath Kanthi Athugalage

B.Sc.(Hons.), Dip.Stat., M.Sc.

Thesis submitted in partial fulfilment of the requirements for degree of Doctor of Philosophy of the Council for National Academic Awards

Dundee College of Technology

August 1983

DECLARATION

I declare that while registered as a candidate for the degree of Doctor of Philosophy I have not been a registered candidate for another award of the CNAA or of a University during the research programme.

[redacted].
(signed)

ACKNOWLEDGEMENTS

I owe a great debt, both intellectual and personal, to Professor Douglas Garbutt, Head of the Department of Accountancy and Economics until December 1982, for the patience and interest with which he administered and supervised this project. This research study was pursued under the constant supervision of Mr. R.C. Brewer, my Director of Studies. I would like to acknowledge my debt to him for his patience and enthusiasm which has been an invaluable stimulus toward the constant working. I express my sincere thanks to Dr. Ian Glover for his supervision, stimulation and for reading and correcting the entire manuscript with great interest and patience.

I also benefitted greatly from my association with the Fraser of Allander Institute, Strathclyde University, and the stimulating technical advice given by Dr. Ian McNicoll.

This research study has been financed by the Scottish Education Department, through Dundee College of Technology and its Research Committee whose Chairman is Dr. D.A. Kennedy. I most gratefully acknowledge their help. I am also very grateful to Mr. M.S. Wijeratne, Director of the Ceylon Institute of Scientific and Industrial Research, for extending my leave to enable me to complete this research.

I must also acknowledge sincerely the help of my former supervisor, Mr. Alan McGillivray for introducing me to this research. I would like to thank also Mr. S. Gardner for his computing assistance.

I wish to express my appreciation to the Secretarial Staff of the Department of Accountancy and Economics, especially to Mrs. Brida Tennant and also to Miss Susan Lees, and Mrs. Eleanor Mollison for their friendly assistance in typing many documents relating to the project, at all stages of this study.

My thanks also go to the officials in all the firms and other institutions in Tayside who provided the information needed to trace the flow of goods and services among the Region's economic sectors. Without their cooperation this study would, of course, never have been completed. I regret that it is not possible to acknowledge all their help more specifically.

I also wish to thank Mr. James Doig for organising the typing work and for checking some of the statistical tables and also to Mrs. Pam Clark, Mrs. Elizabeth Peacock and Mrs. Helen Anderson for typing the manuscript.

Finally I wish to dedicate this study to my husband, Sena, and daughter, Disna. Without their many sacrifices this study would have been impossible.

T.S.K. Athugalage
Department of Accountancy and Economics
Dundee College of Technology

August 1983

The Tayside Economy; An Input-Output Approach to Analysis and Planning By T S K Athugalage.

ABSTRACT

The aim of this study has been to carry out an analysis of the economic structure of the Tayside Region in Scotland using an empirical model. This type of analysis, which can be a major instrument for regional economic planning, has never been used in Tayside. The lack of use of empirical models and reliable statistics may lead to poor decision making which cause inefficiency in allocating limited resources. Therefore, this study attempts to apply a mathematical technique in applied economics to the analysis of the Tayside's economic structure and to assess the use of an input-output approach in regional planning.

In this study data was collected from primary and secondary sources and these were applied in the construction of the survey-based input-output tables and to provide a descriptive analysis of the Tayside economy. Non-survey and balancing techniques available for the construction of regional input-output tables were critically examined. A new method, named "ARAS", was derived by introducing some modifications to the RAS technique with the aims of avoiding some of its weaknesses when it is used in balancing the survey-based input-output tables. The ARAS method which can preserve the positive signs of the Leontief inverse matrices, was used to balance the Tayside survey-based input-output tables. The tables, so constructed, were used to provide an empirical analysis of the structure of the Tayside economy and to demonstrate the applicability of this approach to Tayside's regional planning.

An attempt has been made to assess whether the results of the Tayside survey-based tables could be comparable to those of Tayside non-survey input-output tables. The reason for testing this hypothesis was to provide Tayside planners with some guidance on the feasibility of the use of non-survey tables, since they are more attractive than full-survey and survey-based tables, in terms of saving time and cost of producing the input-output tables.

It is intended that this study may help to stimulate further investigations into the use of this kind of empirical approach in the analysis of regional economies and in their planning.

CORRIGENDA

Page	
7	line 12 for Lientief read Leontief.
26	line 21 insert the before most efficient.
31	line 2 insert the before jute.
31	line 7 for accompnaied read accompanied
35	delete lines 23, 24 and 25.
54	delete lines from 14 to 21.
54	line 22 read precise as detailed.
85	line 5 insert and before in.
85	line 6 insert that after plan.
85	line 8 read is as are.
85	line 17 read ratepayer as voter.
142	lines 17-18 for over-welming read overwhelming.
167	line 10 delete Scottish.
186	line 1 for only transport margin read the transport margin only.
286	line 16 for implies read denies.

CONTENTS

Maps.

Appendices.

Glossary of Abbreviations

ACLQ	=	Adjusted Cross-Industry Location Quotient technique.
EPB	=	Economic Planning Boards.
EPC	=	Economic Planning Councils.
CLQ	=	Cross-Industry Location Quotient technique.
GRIT	=	Generation of Regional Input-Output Tables.
GRP	=	Gross Regional Production.
MLH	=	Minimum List Headings.
NEP	=	National Economic Plan.
N.C.R.	=	National Cash Registers.
RAS	=	R is a diagonal matrix of substitution effects, S is a vector of fabrication effects and A is a national technical matrix.
RIOT	=	Regional Input-Output Table Simulator.
SDP	=	Supply Demand Pool technique.
SIC	=	Standard Industrial Classification.
SLQ	=	Simple Location Quotient technique.
TPD	=	Tayside Planning Department.
TRC	=	Tayside Regional Council.
TRIO	=	Tayside Regional Industrial Office.
$(1-A)^{-1}$	=	Leontief Inverse Matrix.

CHAPTER 1

INTRODUCTION

In the last two decades the construction of input-output tables for regional and local economies has been increasing rapidly. This is reflected in the number of studies, which have recently been completed in the UK, such as in the construction of input-output tables for Kent, the West Midlands, Peterborough, St-Andrews, Sutherland and Shetland. However, regional input-output studies are still regarded as academic exercises in the UK, and their potential for use at the operational level in regional planning is not yet fully exploited.

One of the major difficulties is the construction of full-survey input-output tables within the limitations of the time and resources available to regional planners. The non-survey techniques in the simulation of input-output tables could offer, in this regard, considerable scope to overcome this problem. However, due to various disadvantages of the non-survey simulation techniques, the use of models so constructed in regional planning has been restricted. Therefore, the need for less mechanical techniques, which can produce regional input-output tables with a reasonable degree of approximation to actual tables, and using a limited amount of primary data together with secondary data has recently attracted research interest.

Today, there is a great demand for regional planners to improve the quality of their decision-making processes because of the various constraints of economic development. In this regard, input-output models can provide a useful analytical tool for local decision makers in the UK, since most British regional planning departments have access to computing facilities. The roles of the present regional councils are also diversifying from traditional land use planning to activities along the lines of corporate planning.

Therefore, the main objectives of this study are, first, to produce input-output tables for Tayside using primary data obtained from a sample survey supplemented by secondary data. Second, these survey-based Tayside input-output tables are used for an analysis of the structure of the Region's economy and for the demonstration of the practical ways of incorporating these tables in the work of regional planning.

The first part of Chapter 2 of this study briefly reviews the development of input-output analysis in its present form and of its mathematical framework. The intra-regional input-output model which is used in the Tayside study is also presented in this Chapter. Its second part is devoted to a descriptive analysis of the use of input-output analysis within the context of regional planning. Here an attempt has been made to identify the main characteristics of the development of regional planning machinery in the UK, and to discuss the role of analytical models in regional planning, and specifically the use of input-output model for this purpose.

Chapter 3 analyses more systematically the forces which have been and are at work in determining the structure and growth of the Tayside Region. In this analysis of the structure of the economy which lays the foundation for the assessments made in the succeeding Chapters, an effort is made to apply some principles of macro and micro economics and also to use some statistical techniques such as linear regression analysis and correlation coefficients in order to test hypotheses which emanated from this structural analysis.

An understanding of the local economy is of vital importance for regional planners in their attempts to identify regional needs and problems. The rationale is that, if soundly based economic growth is to return to the Region, it is essential that the strengths and the potential which exist in Tayside should be exploited. An input-output study of a region provides access to a large amount of data which enables the fulfilment of these needs of planning. The review of the Tayside economy is a result of the extensive data collection for the study and it provides a descriptive analysis of the economic situation in the region.

Chapter 4 analyses survey and non-survey simulation techniques available for the construction of regional input-output tables. In this Chapter previous work on simulation techniques is discussed in order to indicate the possible techniques which are less expensive but adequate for meeting the needs of regional planners. A hypothesis is also established in this Chapter assessing whether non-survey input-output tables can serve planning requirements when compared with survey-based input-output tables.

This Chapter also discusses the RAS, or the biproportional method developed by Stone and his research team during the early 1960s. This is perhaps the best known and most widely used technique for revising and projecting input-output tables. It is also used for balancing input-output tables, once they are constructed together with survey-based data and national coefficients. However, little attention has still been paid in the UK to assess its performance as a balancing technique. This Chapter critically examines the feasibility of adopting the RAS technique for balancing the regional survey-based input-output tables.

The research methodology used for the development of the necessary primary data base was a postal survey. The organisation and conducting of this survey took considerable amount of time due to the size of the region, relative to other areas which have been involved with the subject of input-output studies in the UK. Chapter 5 discusses the procedures involved in organising and conducting the survey, ie, the selection of the survey area and of the base year, sector classifications and aggregation, the selection of samples, survey methods and questionnaire design, the efficiency of the survey, and the preparation of the data base.

Chapter 6 presents the methodology involved in the derivation of the survey-based Tayside input-output tables for 1979 and the methods involved in the formulation of the ARAS technique. The aim of developing this technique is to produce a logically consistent methodology for balancing the regional survey-based input-output tables. The modifications introduced to the existing RAS method are first in the process of reconciling the differences between actual and estimated intermediate inputs and intermediate outputs, caused by substitution and fabrication effects. Second, the cells of the structural matrix were replaced by the actual data collected in the survey. The methodological sequence in constructing the Tayside Regional input-output tables, the assumptions of ARAS method, the estimation of control totals for gross outputs, the estimation of final demand sectors and primary inputs sectors are also discussed in this Chapter.

Evaluation of the results of the Tayside input-output tables is undertaken in Chapter 7. In this Chapter, Tayside Gross Regional Production in 1979, sectoral contribution to the GRP, Tayside household income, regional imports and exports, inter-sectoral dependence, and sectoral multipliers are computed and analysed. When the Tayside domestic flow coefficients table is converted into a direct and indirect coefficients table, ie, a Leontief Inverse Matrix, it provides an operational analytical tool with a wide variety of uses, such as for measuring the economic interdependence of the region's economic structure and a set of disaggregated multipliers. These multipliers which are more precise and sensitive than Keynesian income multipliers, are the most important analytical tool used in regional impact analysis. The computed type one and two, production, income, and employment multipliers are analysed critically with the aim of identifying the leading sectors in the economy.

In the absence of an analytical model, planners inevitably make decisions largely on the basis of informed judgements, hunches or wishful thinking. They do not have sound information on the structure of their regional economy in terms of employment, production, income and so on. This system of decision making may help to generate unfavourable impacts upon the economy. Therefore, a need for formal empirical models in regional planning is emphasised. Tinbergen pointed out that "development policy always has to be based on verifiable figures"[1]. Such an emphasis has to be applied in the context of producing more satisfactory policies and strategies, and projections which are consistent with each other and with those for the national economy. The input-output model can thus be a useful analytical tool for providing inputs to the regional planning process. It is this subject that will be discussed in Chapter 8. It provides an assessment of how planners can incorporate the Tayside input-output tables into the construction of their structure plans. It examines the role of these tables as a forecasting model and the application of the tables in the analysis of sectoral inter-dependence, linkage analysis and in the selection of key sectors, and in advancing policies such as import substitution.

Chapter 9 tests the hypothesis established in Chapter 4 regarding the compatibility of the results of survey-based and non-survey Tayside input-output tables, using empirical data. This will be examined in this Chapter with reference to the CHI Square Test, import coefficients, sectoral multipliers and linkage analyses.

Chapter 10 presents conclusions derived from the previous Chapters and makes some suggestions for further investigations.

[1] Tinbergen, J, Development Planning, World University Library, London, 1967, p75.

CHAPTER 2

INPUT - OUTPUT ANALYSIS IN REGIONAL PLANNING

INTRODUCTION

Input-Output analysis as a mathematical technique in applied economics has seen a long historical development. The primitive self-sufficient economic system has changed to a more sophisticated process in which specialization of production and exchange of products within and outside the economy are the major characteristics. In this process interests of economists focussed on examining the interdependence of economic activities in terms of both theoretical and empirical explanation.

The theoretical explanations in this field were initiated about two centuries ago by the French Economist, Francois Quesnay,[1] in 1766. After considerable improvements, contributed in particular, by Walras,[2] Lieontief modified this theory of interdependence of economic activities and pioneered the work on the input-output model. In order to identify the general features of input-output analysis, the development of the model and its mathematical framework will be discussed in the first part of the chapter.

The use of mathematical models together with empirical data in planning has been developed over the past four decades along a

---

1. Eltis W.A., "Francois Quesnav: A Reinterpretation" Oxford Economic Papers, Vol.27, 1975.

2. Walras L, "Elements of Pure Economics". Translation by Richard Irwin, Homewood, Illinois, 1954.

number of alternative avenues. Examination of recent developments in research in this field suggests that there is a widespread interest among regional planners in applying input-output models in their planning processes. The discussion in the second part of this chapter will therefore be focussed on analysing the use of input-output models within the context of regional planning.

2.1 THE DEVELOPMENT OF INPUT-OUTPUT ANALYSIS

2.1.1. DEVELOPMENT OF THE THEORY

Leontief published his work on inter-industry economics in 1936.[3] In this paper he regarded the U.S.A. as a closed economy, so that the input-output model could handle the sectors in which all the goods were intermediate goods and consumables. Consumables were regarded as the intermediate goods needed in the production of personal services. In his later work he corrected this view and developed an inter-industry table for the U.S.A. as an open economy, including final demand sectors determined exogenously.

After his pioneering work there were numerous developments in this field, specifically after the Second World War. Some work has been developed with the main objective of examining new areas in which the input-output model could be applied while other work has been engaged in exploring alternative techniques in order to overcome limitations arising in the practical use of this model.

---

3. Leontief W.W. "Quantitative Input-Output Relations in the Economic Systems of the United States", Review of Economic and Statistics, Vol.18, P.105-125, Aug. 1936.

The construction of national input-output tables was initiated in the 1940's in the U.S.A. In 1939 a 96 sector input-output table for the U.S.A. was developed and it was first used in 1944.[4] The main objective of this study was to estimate the effects of the ending of the Second World War on employment. A 200 sector input-output table was also compiled for the U.S.A. in 1949 which was based on data for about 500 sectors. The latest national input-output table with 370 sectors was published in 1969.[5]

The development of national input-output tables in the U.K. began in the 1950's. These tables for the U.K. economy were constructed for the years 1954, 1963 and 1968. At the same time several others developed and developing countries in the world proceeded with the construction of national input-output tables.

The work on the application of the input-output model to the regions has started since the 1950's.[6] There are two categories that can be identified in the early development of regional input-output models. In the first category the work has been involved in using unadjusted national input coefficients, for the regional input coefficients. Regional input-output tables were constructed using these coefficients together with the regional control totals of gross outputs. The basic assumption was that the national and regional economic structures are identical. In this category the main focus is on single region input-output models which are said to be similar to national tables.

---

4. Richardson, H. Input-Output Analysis and Regional Economy, 1972. P.9 .

5. U.S. Dept. of Commerce. Input-Output Structure of the U.S. Economy 1963, 3 Vols, U.S. Government Printing Office, 1969.

6. Isard, W. "Inter-regional and Regional Input-Output Analysis: A Model of a space economy," Review of Economics & Statistics, V01.33, 1951, pp. 318-28.

The second category of the development in this area is more theoretical and conceptual. The main objective has been the disaggregation of output by sector and by region of origin and destination. By using this method the resultant model can produce inter-regional and intra-regional input-output tables. Isard, for example developed inter-regional and regional input-output tables in 1951.[7] In this second approach a national economic system may or may not be used as the basis of the inter-regional model.

Although it is not possible to review all the literature on the development of these two approaches, it is worthwhile to mention some new developments in this field. The work of Moses[8] in 1955 using very imperfect data and crude estimates, Chenery[9] in his two-region model for Italy, Isard and Kuenne[10] in their Philadelphia study, and Leontief[11] in his inter-regional model added new dimensions to the regional application of input-output analysis.

---

7. ibid.

8. Moses, L. "The Stability of Inter-regional Trading Patterns and Input-Output Analysis," American Economic Review, Vol.45, 1955, pp. 803-32.

9. Chenery, H.B. "The Structure and Growth of the Italian Economy" in Regional Analysis (ed) Chenery, Clark & Cao-Pinna, Rome, 1953, pp. 97-116.

10. Isard, W., Kuenne, R.E. "The Impact of Steel Upon the Greater New York - Philadelphia Urban Industrial Region." Review of Economics & Statistics, Vol.35, 1953, pp.289-301.

11. Leontief, W. "Inter-regional Theory" in Leontief ed al., Studies in the Structure of the American Economy," New York, 1953, pp. 53-90.

The early work on regional input-output analysis in Great Britain can be traced back to 1959. Peacock and Dosser[12] tried to analyse the inter-regional implications of government expansionary programmes.

They suggested the need for regional input-output analysis in analysing the impact of government development strategies. In 1966, Nevin, Roe and Round[12.1] produced a Regional Input-Output Model for Wales. A partial Input-Output Table for Northern Ireland was developed by Steed[13] in 1968. His purpose was to examine the degree of dependency of the regions on external trade and the internal linkages of manufacturing industries.

In the 1960's and 1970's the development of regional input-output research occurred in investigating new techniques to adjust national co-efficients based on primary data. This data has been used to derive the sales and purchase flows and the linkage relationships of the economic sectors. The main limitations of this method is that it is too expensive and time consuming to construct sampling frames and to conduct field surveys, which may be too considerable for the regional planners. More research work has therefore been undertaken to find new methods for simulating national tables for regions using secondary data, which can be more frequently constructed although their validity is somewhat limited.

---

12. Peacock, A.T., Dosser, D.G.M. "Regional Input-Output Analysis and Government Spending", Scottish Journal of Political Economy, No.6. 1959, pp 226-236.

12.1 Nevin, E.T., Roe, A.R., and Round, J.I. The Structure of the Welsh Economy, University of Wales Press, 1966.

13. Steed, G.P. Commodity Flows and Interindustry Linkages of Northern Ireland's Manufacturing Industries, Tijds.Econ.Soc. Geogr.59,1968,pp.245-259.

In view of these two constraints on the survey-based regional input-output tables, new investigations have been proceeding over the last two decades to find a method which can improve the validity of the model with a lesser amount of actual data. The Cambridge Growth Project under Stone developed a method called "RAS"[14] which needs a partial survey, secondary data, and a base national table to elaborate a regional input-output table. Bacharach, Smith & Morrison and Bulmer Thomas examined the principal properties and applicability of this method and have come to the general conclusion that this method can improve the existing methods only to a certain extent and that it is not a complete substitute for the method which only uses secondary data. This argument will be further discussed in Chapter 4.

2.1.2. Input-Output Transaction Table

Each sector of the economy employs the output of many other sectors as its inputs. In this circular flow of goods and services within and outside the economy, the output sold to another industry for further processing is called 'intermediate goods' and output sold to final consumers such as households, government, etc. is called 'final demand goods.' The input-output transaction table consists mainly of the flow of goods and services to and from these two key accounting identities, i.e. intermediate sectors and final demand sectors.

---

14. Dept. of Applied Economics. A Programme for Growth, Part III, Input-Output Relationships, 1954-1966, University of Cambridge, 1963.

A detailed description of the input-output table is beyond the scope of this study and it is well illustrated in the literature. For the purpose of this study the input-output transaction table is briefly discussed here in mathematical terms.

(TABLE 2.1)

TABLE 2.1. INPUT-OUTPUT TRANSACTION TABLE:-

To / From	Purchasing Sectors										Total Gross Outputs
	Intermediate Sectors				Total Intermediate Demand	Final Demand				Total	
	1	2	j	n		C	I	G	E		
1	x_{11}	x_{12}	x_{1j}	x_{1n}	W_1	C_1	I_1	G_1	E_1	Y_1	X_1
2	x_{21}	x_{22}	x_{2j}	x_{2n}	W_2	C_2	I_2	G_2	E_2	Y_2	X_2
i	x_{i1}	x_{i2}	x_{ij}	x_{in}	W_i	C_i	I_i	G_i	E_i	Y_i	X_i
n	x_{n1}	x_{n2}	x_{nj}	x_{nn}	W_n	C_n	I_n	G_n	E_n	Y_n	X_n
Primary Inputs (Value Added)	V_1	V_2	V_j	V_n		V_C	V_I	V_G	V_E		V
Total Gross Inputs	X_1	X_2	X_j	X_n		C	I	G	E		X

This table illustrates the transactions between producing sectors and intermediate sectors, between producing sectors and final demand sectors, between primary inputs, i.e. labour, tax, and other value added, and intermediate sectors and finally the transactions between primary inputs with the final demand. These relationships can be explained as follows,

$$
\begin{array}{l}
x_{11} + x_{12} \cdots\cdots\cdots\cdots + x_{1j} \cdots\cdots\cdots + x_{1n} + Y_1 = X_1 \qquad (2.1) \\
x_{21} + x_{22} \cdots\cdots\cdots\cdots + x_{2j} \cdots\cdots\cdots + x_{2n} + Y_2 = X_2 \\
\vdots \\
x_{i1} + x_{i2} \cdots\cdots\cdots\cdots + x_{ij} \cdots\cdots\cdots + x_{in} + Y_i = X_i \\
\vdots \\
x_{n1} + x_{n2} \cdots\cdots\cdots\cdots + x_{nj} \cdots\cdots\cdots + x_{nn} + Y_n = X_n
\end{array}
$$

In these equations transactions taking place with primary inputs and purchasing sectors have not been considered since they are of less importance compared to the producing sectors of the economy as far as transactions are concerned. The final demand sectors are also aggregated into one column for simplicity of calculation.

Simplifying equation 2.1,

$$\sum_{i=1}^{n} x_{ij} + Y_i = X_i \qquad (2.2)$$

The inter-industry technical co-efficients or cost structure for each sector can be defined as

$$a_{ij} = \frac{x_{ij}}{X_j} \qquad (2.3)$$

Assuming that the demand for the output of X_i sector by the sector X_j is a unique function of the level of production of sector

X_i, and there will be no substitution or fabrication effects on the sector X_j we can obtain the following relationship from 2.3.

$$x_{ij} = a_{ij}X_j \qquad (2.4)$$

Substituting 2.4 into 2.1, following set of equations can be formed,

$$\begin{aligned}
a_{11}X_1 + a_{12}X_2 + a_{13}X_3 \,\dots\dots\dots + Y_1 &= X_1 \qquad (2.5)\\
a_{21}X_1 + a_{22}X_2 + a_{23}X_3 \,\dots\dots\dots + Y_2 &= X_2\\
\vdots\\
a_{n1}X_1 + a_{n2}X_2 + a_{n3}X_3 \,\dots\dots\dots + Y_n &= X_n
\end{aligned}$$

The final demand sector Y_i can be isolated by regrouping,

$$\begin{aligned}
X_1\ (1-a_{11}) - a_{12}X_2 - a_{13}X_3 \dots\dots\dots a_{1n}\,X_n &= Y_1 \qquad (2.6)\\
-\ a_{21}X_1 + (1-a_{22})X_2 - a_{23}X_3 \dots\dots -a_{2n}X_n &= Y_2\\
\vdots\\
-\ a_{n1}X_1 - a_{n2}X_2 - a_{n3}\,X_3 \dots\dots +(1-a_{nn})X_n &= Y_n
\end{aligned}$$

The equations 2.6 can be converted into matrix form as follows,

$$\begin{bmatrix} (1-a_{11}) & - a & \dots\dots & - a_{1n} \\ -a_{21} & +(1-a_{22}) & \dots\dots & - a_{2n} \\ \vdots & & & \\ -a_{n1} & - a_{n2} & \dots\dots & +(1-a_{nn}) \end{bmatrix}_{nXn} \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix}_{(1Xn)} = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix}_{(1Xn)} \qquad (2.7)$$

Simplifying the above matrices, we get,

$$(I-A)X = Y$$

$$X = (1-A)^{-1}\,Y \qquad (2.8)$$

where $(1-A)^{-1}$ is called the "Leontief inverse".
This inverse matrix will be used in this study to obtain the multipliers of hypothetical changes in final demand or gross outputs of the Tayside Region.

The regional input-output model is basically similar to the above national model. The difference between these two models emerges because the regional input-output models include the inter-regional transactions of goods and services. The sales of sector i and inputs purchased by sector j are identified by their destinations and origins. The regional model can therefore be illustrated as follows,

$$ {}_{r}X_{i} = \sum_{j=1}^{n} \sum_{S=1}^{m} {}_{rs}X_{ij} + \sum_{S=1}^{m} {}_{rs}Y_{j} \qquad (2.9) $$

Production co-efficients can be derived as,

$$ \frac{{}_{rs}X_{ij}}{{}_{r}X_{i}} = {}_{rs}a_{ij} \qquad (2.10) $$

The co-efficient ${}_{rs}a_{ij}$ has a spatial as well as a technical component.

This model needs a disaggregation of intermediate sectors and final demand sectors by origins of purchases and destinations of sales. Having identified the regions, the model can express the total output of i sector in the region 'r' as the summation of sales of i sector to region 'r' and region 's' and the sales to final demand sectors in all of the regions.

The application of this model to the multi-regional inter-industry analysis requires a substantial amount of data. It needs an analysis of inter-regional inter-industry relations which in turn requires a measurement of inter-regional trade flows. Thus the derivation of these trade flows between regions is the key factor in the inter-regional model. Because of the complex nature of this model no complete inter-regional input-output model has been published, although much research work has been carried out. The solution for this limitation is to develop input-output tables for the single region.

The model used in the present study for the Tayside Region is a single regional input-output model. In this model there is only one region considered, i.e. Tayside, and the transactions taking place with areas outside the region are designated as exports and imports. The inter-inudstry transactions are limited to the Tayside region only and this model may therefore be viewed as a sub-system of the Scottish Input-Output model.

2.2. INPUT-OUTPUT MODELS IN REGIONAL PLANNING

2.2.1. REGIONAL PLANNING IN GREAT BRITAIN

Planning at the national or regional level is oriented towards the future. It is now widely recognised that planning in one form or another cannot be dispensed with by any country which needs to raise the standard of living of its members, especially when there is a limited amount of resources accompanied by various social, physical and economic problems. The resources should be allocated in such a way that the maximum benefit can be obtained by utilising them in the most needed areas in the economy. To attain this, strategies should be devised taking future requirements of resources and a desired rate of growth into account.

Regional planning is concerned with the "ordering of human activities in supra-urban space, that is in any area which is larger than a single city."[15] This definintion discloses two issues, firstly, the main function of regional planning and secondly, what is meant by the term "region". However, this definition does not say much about the function of regional planners regarding the non-human resources of the region. At the regional level much of the emphasis is on the economic problems of the allocation of human and non-human resources and their development. The above definition can therefore be modified to "regional planning is the process of formulating and clarifying social physical and economic objectives and devising appropriate strategies to attain the objectives allocating regional resources within the political framework of local and national government". Regional planning can also be viewed as providing an input into the national planning and as a basis for co-ordinating local plans.

Regional planning has its roots in the Great Depression in the U.S.A. The main function of regional planning authorities was to control and develop the water resources of the area in question. After the Second World War, the regional problems were complicated. Some old industrial regions were unable to follow the growth of the dynamic industries such as the chemical, synthetic and electronics

15. Friedmann, J. & William Alonso, (ed) Regional Development and Planning, The M.I.T. Press, Mass. Cambridge, 1964, P.63.

industries etc., and new regions had rapid industrial development accelerating the growth of industrial and commercial investment. The function of regional planning had to expand to meet the new challenges arising from industrial development.

Over the last few decades regional planning in Britain can be explained as the consequence of two active movements. One movement has focused upon the problems of city or urban areas and is largely social. People from agricultural areas moved to the cities for better employment. The living conditions in the cities were congested as the public services particularly in relation to gas and electricity supply, water, housing and transport were not sufficient. The result was that new political and economic problems were created in these densely populated central areas.

The other main regional planning movement has been concerned with the problem not of urban regions but of regions suffering from unemployment and industrial stagnation. As a result, especially after the Second World War , the U.K. has been experiencing a slow rate of growth compared to her industrial counterparts. One important fact even today is, that some regions are suffering constantly a low rate of growth followed by higher rates of unemployment than other regions. The South East region in the U.K. for example had the highest average weekly income per person (£57) and per household (£153) in 1979-80, while Northern Ireland had the lowest in each case, £38 and £113 respectively. Consequently the aggregated growth rate for the whole economy shows a much lower figure concealing the fact that some regions are experiencing high rates of growth with lower levels of unemployment.

Therefore,the rationale for regional planning in the U.K. derives partly from inequalities in regional economic growth between the urban and rural areas and partly from the need for a tool for comprehensive national development in which all parts of the country would contribute in their own ways to achieving the national objectives.

More effective initiatives for regional planning in the U.K. can be traced back to the Barlow Report, published in 1940.[16] This report has been considered as the foundation of post war British planning. It emphasised the need for a national agency which should be established with the objectives of redeveloping congested urban areas and encouraging a resonable balance of industrial development throughout the regions of Britain. This report also showed the relationship between physical and economic planning, and the advantages of regional planning. The Barlow report recommended that planning should be carried out regionally and nationally. The Beveridge White Paper on Employment Policy in 1944[17] followed many of the recommendations of the Barlow report.

The system of regional planning in Britain was provided mainly by the Town and Country Planning Acts, the Distribution of Industry Acts, the National Parks and Access to the Countryside Act, the New Towns Act and the Town Development Act. The 1947 Town and Country Planning Act brought almost all development under control by making

---

16. Report of the Royal Commission on the Distribution of Industrial Population, Cmnd: 6153, HMSO, 1940.

17. Employment Policy, Cmnd: 6527, HMSO, 1944.

it subject to planning submission. Under these acts, Development Plans were to be prepared for every region and sub-region of the country.

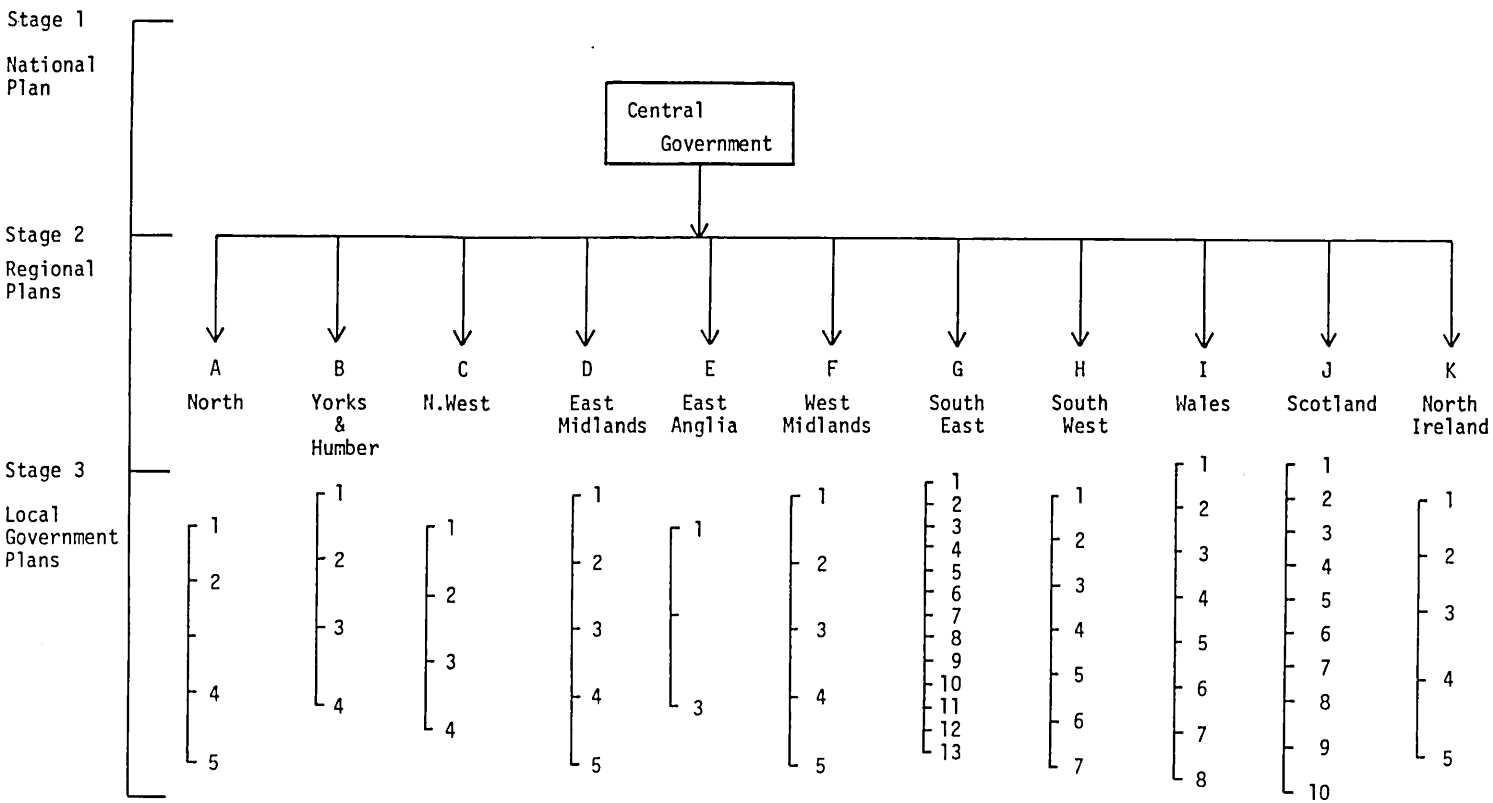
At present national policy implementation in Britain has been decentralised to certain levels by the establishment of regions and sub-regions throughout the country. Each region/sub-region has a council and each regional council has the authority to establish and implement some policy decisions. Planning decisions, specifically for local government are clearly related to police, health, education, welfare, cleansing and the efficiency of many private and public investments and expenditures. Local government has power to influence the regional distribution of development.

Fig.2·1 shows the hierarchy of planning in the U.K., which was introduced by the labour government elected in 1964. The national plan, in stage one a five-year plan[18], was constructed and published by the Department of Economic Affairs. Primarily it was a resources budget, estimating the resources which would be nationally available and laying down the proposals for the way in which they should be efficiently utilised. It is clear that the first national plan attempted to specify targets in terms of growth of output, changes in productivity, growth of employment and capital investment for the period up to 1970. The regional plan at stage two needed to be within the constraints of the national economic plan.[19] At stage three, local government authorities had to produce the

18. H.M.S.O. 'The National Plan, 1966-1970, Cmnd: 2764, 1965.

19. The relationship between national plan and regional planning, and between regional planning and local structure planning are well discussed by the Planning Advisory Group. See for details, Tress, R.C. "The New Regional Planning Machinery and its Research Needs", Regional Studies, Vol.1, 1967, p.25.

Figure 2.1. Hierarchy of Planning in the U.K.



A
1. Cleveland
2. Cumbria
3. Durham
4. Northumber-land
5. Tyne & Wear

B
1. Humberside
2. N.York
3. S.York
4. W.York

C
1. Cheshire
2. Greater Manchester
3. Lancashire
4. Merseyside

D
1. Derbyshire
2. Leicester-Shire
3. Lincolnshire
4. Northampton
5. Nottingham-shire

E
1. Cambridge
2. Norfolk
3. Suffolk

F
1. Hereford & Worcs.
2. Shropshire
3. Staffordshire
4. Warwickshire
5. W.Midlands

G
1. Beds.
2. Berks
3. Bucks
4. East Sussex
5. Essex
6. Gr.London
7. Hants
8. Herts
9. I.O.W.
10. Kent
11. Oxon
12. Surrey
13. West Sussex

H
1. Avon
2. Cornwall
3. Devon
4. Dorset
5. Glouces.
6. Somerset
7. Wiltshire

I
1.Clywd
2.Dyfed
3.Gwent
4.Gwynedd
5.Mid-Glamo.
6.Powys
7.South Glamo
8.West Glamo

J
1. Borders
2. Central
3. Dumfries
4. Fife
5. Grampian
6. Highland
7. Lothian
8. Strathcylde
9. Tayside
10. Islands

K
1. Belfast
2. South-Eastern
3. Southern
4. North-Eastern
5. Western

structure plans for a specific period. (The role of the structure plan in the regional economy with special reference to the Tayside Region is discussed in Chapter 3 in detail.)

An Economic Planning Board and Economic Planning Council were established for each region of the country. The EPB consisted of civil servants drawn from Ministries and government departments. The EPC's acted as advisory bodies. Their members were drawn from industry and commerce, local governments and trade unions and universities. These EPBs and EPCs were primarily responsible for producing reports and studies for their regions in order to incorporate them within the overall framework of national policy. One of the first regional plans, constructed in this way was the White Paper on the Scottish Economy, published in January, 1966.

This planning system was supposed to cover the U.K. comprehensively. However, recent developments in regional planning have been bleak. It is not clear how far the problems of sub-regions will or should be absorbed into the above mentioned machinery. Nevertheless, the regional policy instruments such as new development areas and industrial estates, for example, are controlled by different government departments with different objectives, in different regions. Therefore, it seems that the practical use of this machinery in all the regions in the U.K. is still uncertain.

2.2.2. THE CASE FOR EMPIRICAL MODELS IN REGIONAL PLANNING

Academic research into the regional economics in Britain is mostly descriptive. Theoretical analysis based on empirical data which is designed for the particular regions within the national economy is not yet commonly used. The use of operational models in the planning process may be justified on a number of grounds.

One is that the planners should have a comprehensive understanding of the local economy, before devising the necessary aims and strategies. Understanding of an economic system is a difficult task as the given region's economy may or may not be a sub-system of other groups in society. It is also true that a region is a sub-system of a country as a whole. This means the region is not a closed economy, but is an open economy with trade relationships with other regions, the rest of the country or the rest of the world. On the other hand, in a modern economy, production tends to be highly specialised and industries are often dependent on many others. Thus it is of prime importance to study those relationships and the impacts of changes on the region's economic activity. The understanding of the region's economy cannot be achieved without an economic study based on a proper analysis.

When this knowledge has been gained the next step is to draw up the objectives and policy instruments. The essential properties of these policy instruments are, firstly that they should have a clearly defined set of objectives and secondly, they should be able to measure the economic effects of alternative policies and evaluate the proposed programmes and projects.

Capital rationing, for example, is the major constraint that any regional planner may encounter. He should decide how to allocate the limited funds in ways which will maximise the use of the resources. The major objective of any regional plan is to increase the internal level of employment and regional income. To achieve these goals, he may have a specific set of alternative investment proposals. The problem will then arise concerning the selection of activities which could make for the largest level of income and employment opportunities. This evaluation can be carried out by estimating impacts of these proposals upon the rest of the region, and estimating multipliers. The rationale behind this is the fact that new programmes or projects may produce impacts on the region which may be unexpected and undesired for the existence of a balanced economic structure. On the other hand, the main role of any regional plan is to make forecasts of the main economic determinants for the future. Therefore there should be an analytical model which is designed to fulfil the required properties of the regional plan.

Currently the construction of the regional plan is done in two stages. In the first stage the planners should work out the corporate plan in order to identify most efficient allocation of a local authority's resources in relation to its aims and objectives. Structure plan, in the second stage should be produced with the help of the corporate plan. The structure plan indicates the most essential areas for development during the next planning term and the availability of land required for the target level of industrial and physical development. In this planning process, planners need to work out some estimates. It is clear that planners are not permitted to do experiments within the constraints of limited funds in order to obtain these estimates. It is possible that planners are dependent on guesswork for this type of estimate. In the past, for example, some planning decisions in Scotland have been taken about unemployment, industrial mobility and other related problems based only on employment data.[20] Many authors such as Hewings[21] pointed out that many regional planning decisions enacted in Britain have been made on the basis of rather spurious analysis. He also stated that the impact of these decisions on the region, for example, direct and indirect, and induced changes have not been considered. The underlying assumption is that regional changes in employment are a reasonably accurate reflection of changes in real income. Thus other possible endogeneous and exogeneous factors, e.g. regional investment, national government policies etc., which cause changes in regional income, have not been considered. Taking into account the time involved, and the consequences of the false recognition of regional problems, regional planners now tend to accept the use of operational models compiled by independent researchers.

Nevin, Roe and Round emphasised the need for an analytical framework in planning and stated "The preparation of a development plan for Wales (as for other regions of the U.K.) is now underway as a matter of urgency and a regional plan cannot begin to make

---

20. McKay, J. "Industrial Structure and Regional Growth, A Methodological Problem," Scottish Journal of Political Economy" Vol.15, 1968, pp. 129-143.

21. Hewings, G.L.D. "Regional Input-Output Models in the U.K." Regional Studies. Vol. 5, 1971, P.12.

economic sense without the use of some such analytical framework."[22] In suggesting the necessity for having strong political leadership and community support for a plan for regional development, Leontief pointed out that the development progress "will be faster along a road well mapped in advance and the cost of progress in terms of labour, capital and human sacrifice considerably less if regional planners use the analytical tools currently available to them."[23]

In the last few decades many researchers have developed analytical techniques which can be used in regional planning. Although a detailed review of these theories is beyond the scope of this study, it is felt a brief discussion on these techniques will be relevant.

The use of the linear programming model in national planning is widely discussed. However its use in regional planning is still in the experimental stage. The main interest in this model for regional planning is connected with the fact thatfuture requirements of all the sectors in the regional economy can be programmed subject to the various constraints, for example, capital, labour capacity, etc., in order to achieve the objectives of the plan. The planners should have an understanding of how much capital can be spent, the availability of skilled and unskilled labour and the capacity utilisation of individual sectors. When the resources have been quantified the objective function and the constraints can be worked out and by solving these separate equations planners

---

22. Nevin, Roe & Round. "The Structure of the Welsh Economy." 1966, p.1

23. Leontief, W.W. "Dynamic Analysis" in "Studies in the Structure of the American Economy." ed by Leontief, W. New York, 1953, pp. 53-90.

can derive conclusions on the appropriate strategies for the development of the economy. The final solution of this kind of programme also indicates what sectors should be given priority during the planning period. At the sectoral level this model indicates the substitution effects, price changes and shadow prices and this is one of the important characteristics of this analysis.

The limitation of this model as a technique for regional planning is that it cannot be used for the analysis of inter-industrial dependence or multipliers created by change in real income etc. and for the general impact analysis.

During the last few years much effort has also gone into developing a system of regional accounts. In this field the major concern has been to build a model to analyse the key aspects of regional economic activities within an accounting framework. As national accounts are based on macro-economic information, these accounts also are highly aggregative. In these accounts the regional gross national product (RGNP) is subdivided into a limited number of categories e.g., investment, household, local government, etc. Thus the use of regional accounts in planning is limited. Nevertheless it is quite clear that any single aggregated regional account is not able to handle the requirements of planning which are more complicated.

Therefore, a more appropriate way of handling the regional needs is to develop a major account accompanied by a number of subsiduary accounts. The accounts in these two stages should be incorporated into each other thoroughly. Thus the regional input-output model appears to be the most efficiently adapted system for coping with the needs of regional planning. This will be examined in the next section.

2.2.3. THE INPUT-OUTPUT MODEL AND REGIONAL PLANNING

The input-output model has a dual function in regional planning. In constructing the regional plan it has to quantify regional gross output, regional investment, savings, employment level, etc., in order to lay down the future development programmes. The aggregates of the final demand sectors and the primary input sectors of the input-output table provide planners with macro-economic information and this will mainly facilitate the comparisons of their performance with those of other regions, relative to the nation as a whole. Secondly, as a micro-economic technique, it provides planners with disaggregated information about each and every sector of the region.

One of the major areas of application of the input-output model in regional planning is in the provision of an economic analysis of the transactions occurring in the region during a certain period of time. Reading along individual columns and rows of the table the planners can obtain an understanding of the sectoral performance in providing goods and services and they can incorporate this micro-economic analysis in deriving the policy issues.

The analysis of inter-dependence is a major advantage of this model. For example, the output of the textile industry[24] in the Tayside Region depends mostly on the production of jute industry. The output of clothing, carpets and other related industries depends on the output of the textile industry. In general terms, the amount of sales of industry 'i' to say industry 'j' depends on the output of industry 'j' because an increase in the output of any industry must be accompnaied by an increase in the consumption of various inputs. Thus the analysis of backward and forward linkage relationships between individual sectors of the economy can play a significant role in the decision making process in regional planning.

One distinctive feature of this analysis is its ability to check the consistency of a set of given information. This implies, for example, consistency between the estimates of regional gross output and regional gross expenditure, between household consumption and labour payments, between regional savings and regional investment etc. The consistent methodology of this model thus provides planners with an information flow system which allows them to simulate alternative conditions within a clearly defined analytical framework.

The constant input co-efficient matrix which is called a 'Leontief Inverse Matrix", can be contructed mathematically from the inter-industry transaction table. Then it becomes an operational tool with a wide variety of uses. The indirect effects of changes in key variables which are more precise than Keynesian income multipliers can be measured using this inverse matrix. This

24. The textile industry has been considered as an aggregated sector.

matrix is also used for the purpose of short term and long term forecasting which are among the main objectives of the regional planning.

The role of planners in the development of the regional economies has widened with the rising level of unemployment. A major objective of any regional plan today is to reduce the level of unemployment. Therefore the policy instruments should obviously aim to increase the employment opportunities and at the same time it should be borne in mind that the policy instruments should not be designed so as to reduce the regional income. This means that people should be employed in productive activities.

Before deriving the strategies it is essential to find out the reasons for sectoral unemployment. The reasons may include a decreasing level of demand followed by slow growth of industrial output and other factors. However, it is clear that there are linkages between the levels of employment in each related industry. The underlying assumption is that employers do raise the demand for labour not only for increasing the level of income but for their work contributed to the production. For example, the level of employment in a components firm depends largely on the demand for components from other user industries. In turn this will be reflected in the level of employment in the assembling industry. This means if the demand for assembled products is lower, it will affect the level of employment in this industry. When the demand for assembled products is lower, it will affect the demand and the level of employment in the components industry. This relationship is referred to as employment linkage. The input-output transaction table helps planners to quantify the linkage effects of employment which in effect allows them to devise appropriate policy instruments.

The formulation of development strategies for local government requires an anlysis of the effects of given types of policy issues on certain economic variables measured in quantitative terms. This aspect of impact analysis is one of the major areas for which input-output studies have been undertaken. The main characteristic of the regional input-output model developed in recent years is that it has been done within some problem solving framework.[25]

Thus the input-output model can be regarded as a policy oriented analysis. The development policy is assumed to raise the regional income and is concerned to find the ways and means to increase the employment opportunities and physical development of the region. The policy instruments available for this purpose may be for example, central and regional government spending. For the efficient use of these instruments there needs to be a device to evaluate them. The present input-output tables for the Tayside Region together with the Leontief Inverse will provide this assessment along with information which planners need to know in advance.

---

25. For example in U.S.A. "The impact of Steel upon the Greater New York,"by Isard and Kuenne (1953), and "Impacts of the Space Programme on a Local Economy" by Miernyk (1967) are some of the studies in this line. This characteristic has also dominated in the U.K. For example McNicoll (1976) examined the impacts of oil related industries on Shetland economy. McDowall & Blake (1968) also centred their study on analysing the impacts of St.Andrews University and Tourism on the Local economy.

These tables can be included in the existing system of planning both at the preliminary stage and the concluding stage, i.e. balancing and co-ordinating the plan indices. At the preliminary stage of planning, these tables can be used as instruments to work out control figures at the regional level. In the concluding stage these tables can play a major role in achieving the full consistency of plan indices and in co-ordinating the central government decision making authorities.

The main limitation of the application of input-output tables in regional planning stems from the assumptions upon which it is based. The uses of fixed technical co-efficients have been strongly criticised. For example, Tiebout[26] has argued that "the fixed co-efficients at the national level is at all dubious, even more is left to be desired at the regional level". He also pointed out that trade patterns vary from region to region and therefore it is risky to assume the stability of trade co-efficients.

The other principal assumption of this model is the linear production relationship. This means the amount of purchases of any sector from other sectors (except final demand sectors) is determined according to the assumed technical relationship, and by the level of the output of the purchasing sectors. The effects of substitution, productivity of the production factors and of economies of scale are not considered in this model.

26. Tiebout, C.M. "Regional and Inter-regional Input-Output Models: An Appraisal," Southern Economic Journal, Vol.24, 1957, pp.140-7.

On the other hand this linear production function is not very meaningful in many non industrial sectors such as trade, service industries and the public sectors. It is also found this model cannot be used for the analysis of technical changes, such as the appearance of new industries, obsolescence and the disappearance of old industries.

Finally there are a number of ways that the input-output model can contribute to regional planning. It can be introduced to the plan at any stage depending on the methodology used by planners in constructing it. However there are some weaknesses in this model in relation to planning. Tiebout's comments on this line can be thought of as a milestone in the rapid development of regional input-output studies in the 1950's and the 1960's. As a consequence, some important regional input-output studies have been developed more recently with the aim of answering Tiebout's comments, for example W. Virginia Input-Output Study by Miernyk (1971) in the U.S.A. and Regional Input-Output models in the U.K. by Hewings (1971).

The main advantages of this model in regional planning may be summed up briefly. This model, unlike other analytical models, is empirically applicable in regional planning provided that a sufficient amount of data on inter-industrial relationships is available. It is also possible to use money values as a measure of co-efficients and the relative price changes do not distort too much the pattern of purchasing and selling. Even if the input-output table is out of date it can still show sectoral behaviour in the regional economy and its predictive power is comparatively successful when it is used with some current data and information.

CHAPTER 3

ECONOMIC REVIEW AND TAYSIDE REGIONAL PLANNING

INTRODUCTION

This chapter is not intended to be a comprehensive study of the Tayside economy. It is designed to draw attention to the chief characteristics of the Tayside economy which have given rise to the present regional policies and strategies. Attention will be focussed therefore, in this chapter, on the discussion of these main features and in particular on population, industry and employment, and associated structural changes. The aim of this analysis is to produce background information for discussion and assessment in the later chapters particularly, of the possible avenues for incorporating the input-output model into the formation of regional policies and for evaluating the impact of various development strategies upon the economy.

3.1 ECONOMIC REVIEW OF THE TAYSIDE REGION

3.1.1 LOCATION

The Tayside Region, which consists of wide lowlands and rounded hills, lies between the Highland Front and the North Sea. It covers approximately 7,500 square kilometers and contains the natural drainage systems of the rivers Earn, Tay, Tummel, Garry and Esk. The lowlands of the region contain some of the most productive arable land in the whole of Britain.[1] The Tayside Region also lies at the end of the Industrial Central Belt of Scotland. Figures 3.1 and 3.2 illustrate the geographical situation and the location of Tayside Region in Central Scotland.

The boundaries of the Tayside Region are quite open towards the south, but they are more sharply defined in other directions by the coast and the hills. In 1975 the re-organisation of local government under the Local Government (Scotland) Act 1973 replaced the counties and burghs by three district councils, namely, Dundee, Angus, and Perth and Kinross, and excluded the North of Fife from the Tayside Region. These changes, specifically the exclusion of the North of Fife, have brought about significant impacts upon both the region's administration and the economy. The major effect of these changes upon the present study is the difficulty in making available a continuous flow of statistics over the last two decades. The effect of this position will be indicated in the sections which discuss structural changes in the population and the economy of Tayside over the past decade.

3.1.2 POPULATION STRUCTURE AND CHANGES

One of the main functions of a structure plan is to analyse population structure and to make forecasts for the next few years or decades. The derivation of objectives and policies of the structure plan are normally based on the projections of population

---

1. McIntosh, I.G. and Marshall, C.B. The Face of Scotland, 3rd ed. London, 1977, p.19.

Fig. 3.1 Geographical Situation of Tayside

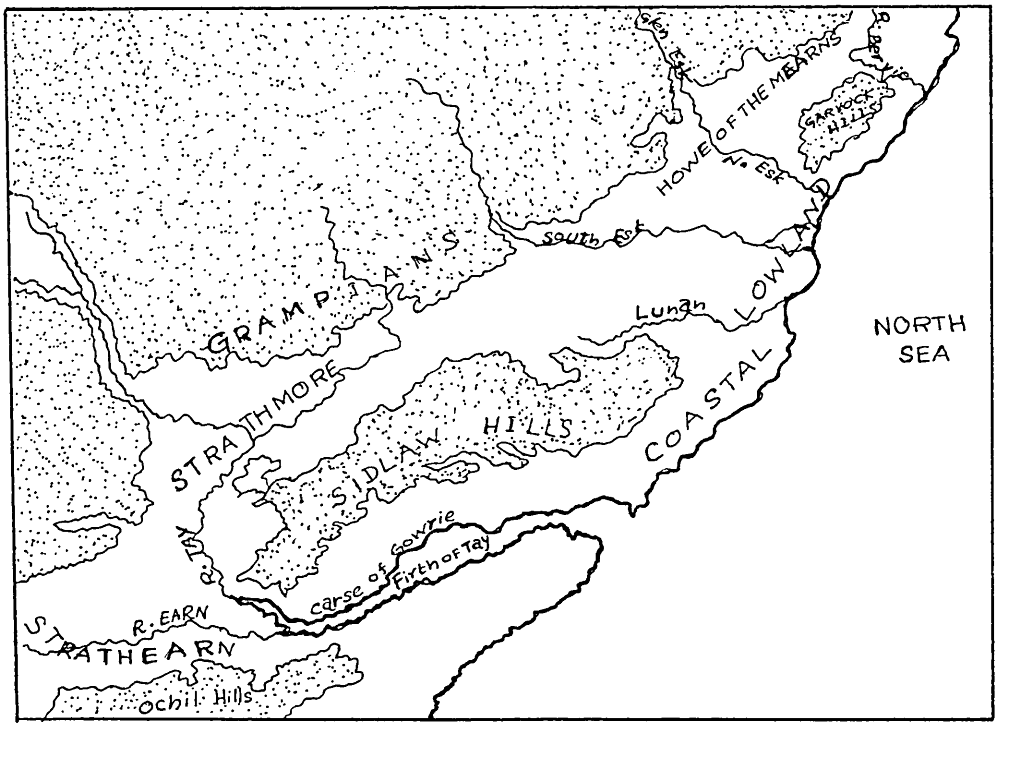
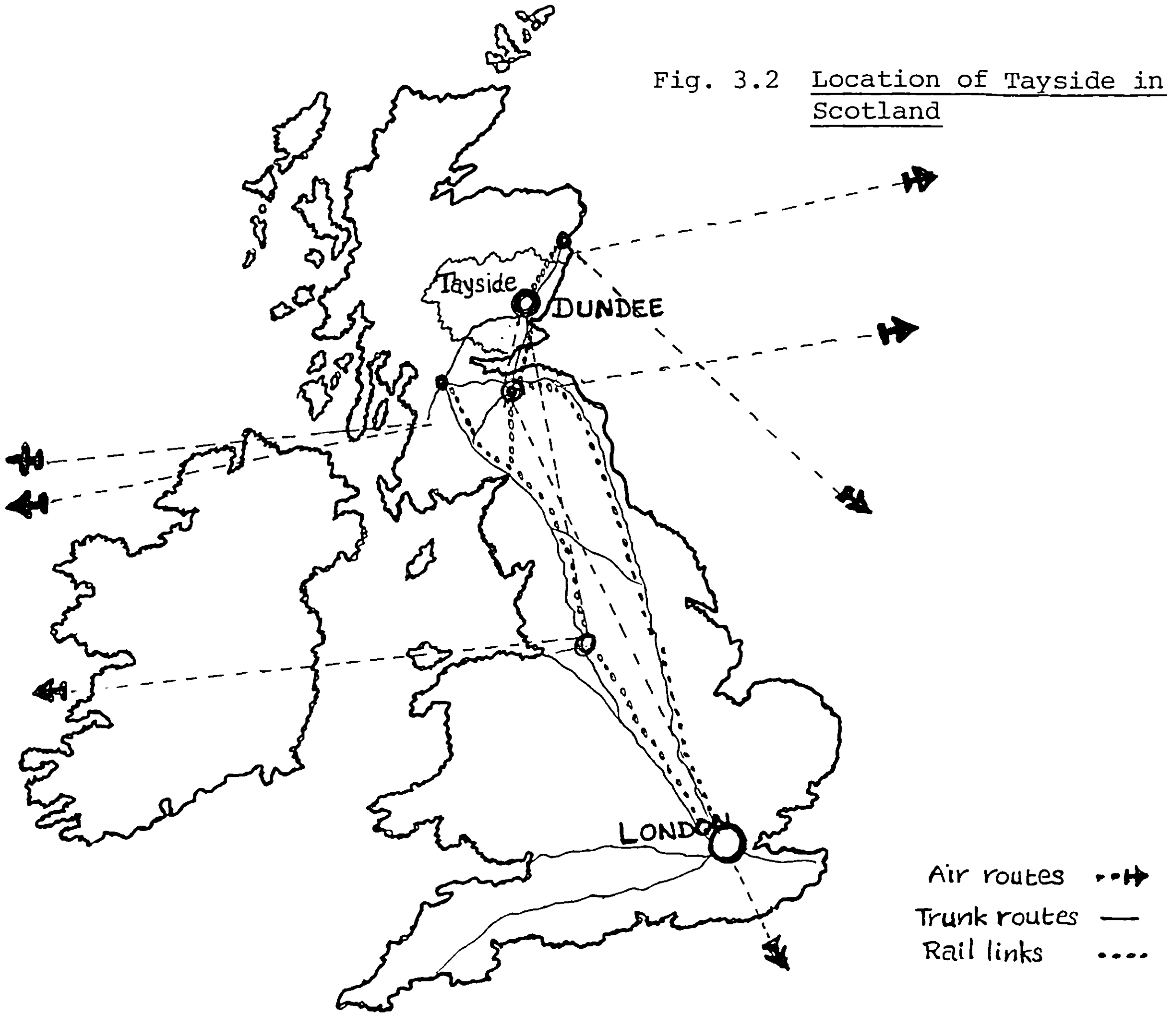
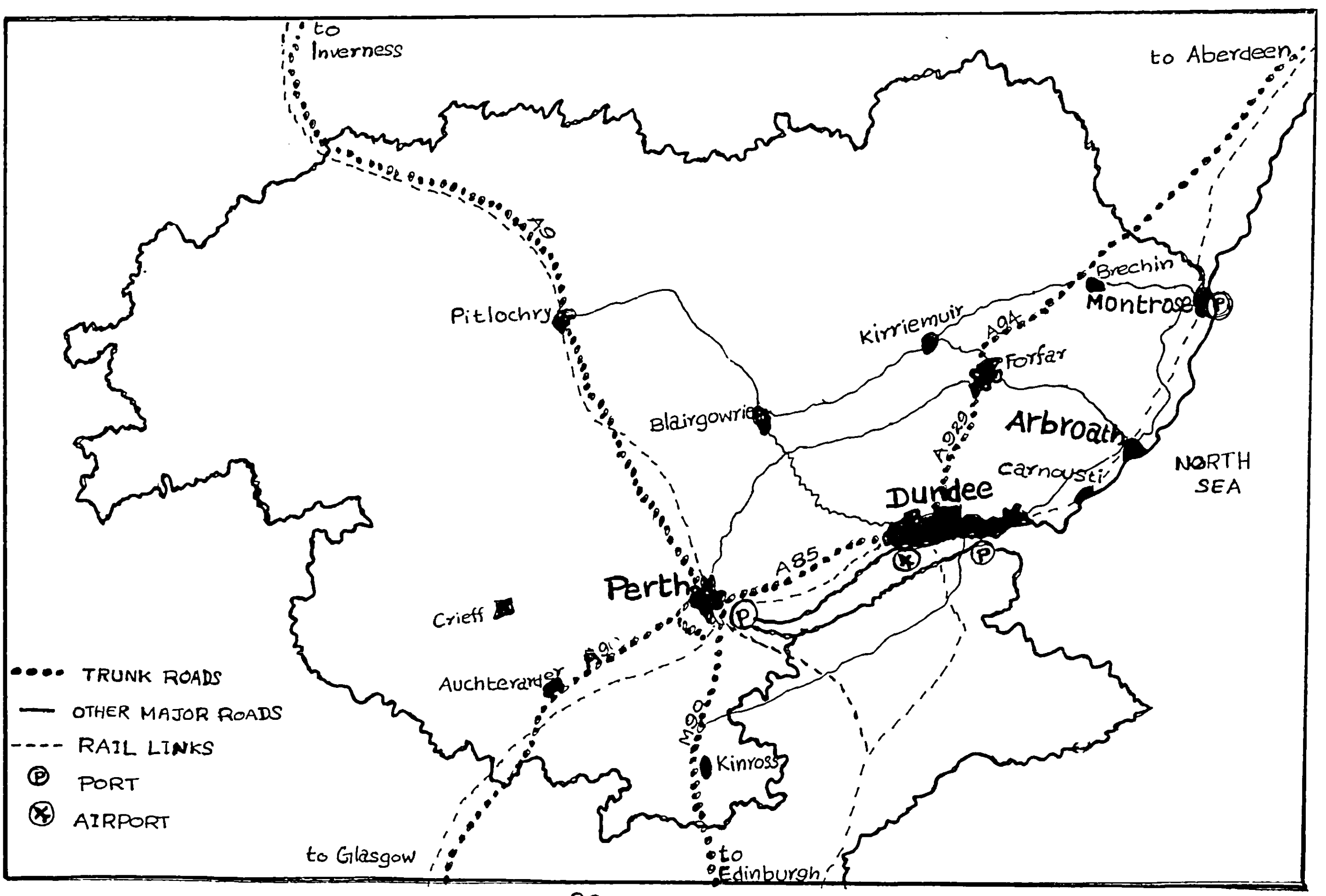


Fig. 3.2 Location of Tayside in Scotland





and employment. On the other hand, population studies facilitate the projections of the size of the markets for regionally produced goods and services. This is due to the fact that when the population is increasing then the consumers' purchasing power may also be increasing according to the typical behaviour of the consumers and the incomes available to them. Population studies also help to assess the labour market in the region. The projections concerning labour markets influence significantly the establishment of policies for attracting foreign investment or for diversifying existing industries. Population studies can also provide reasons for the difference in per capita income when it is compared to other regions. The variations in the structure of the population, i.e., the distribution of working and non-working population lead to changes in per capita income. Therefore, it is worthwhile to examine past trends in the population, structure of population and the impacts of population changes on other areas in which policy decisions must be made.

Table 3.1 shows some population trends in the Tayside Region between 1971 and 1980. It illustrates that the population was growing until 1978, and thereafter it has begun to decline.

Table 3.1

Annual Changes of Population in Tayside, 1971-1980

	Total Population ('000)	Change of Population ('000)	Natural Increase ('000)	Migration ('000)	Other Changes ('000)
1971	396.5	0.0	0.7	-0.7	0.0
1972	396.5	1.1	0.2	0.6	0.3
1973	397.6	3.6	-0.1	3.5	-0.6
1974	401.2	0.8	-0.4	0.8	0.4
1975	402	0.2	-0.4	0.5	0.0
1976	402.2	-0.2	-0.4	0.8	-0.6
1977	402	1.0	-0.5	0.8	0.6
1978	402.9	-1.3	-0.4	-0.9	0.0
1979	401.7	-2.5	-0.6	-2.0	0.1
1980	399.2				

Source:- Registral General Scotland, Annual Report for 1981 H.M.S.O. 1982

The main resons for these fluctuations of population are the natural increases of population and migration. The natural decrease of population, in terms of births and deaths,has been offset by the increase in net migration during the period 1971-1978, resulting in an increase in the total population. As shown in Table 3.2, the population in Tayside shows a fair increase during 1971-1978, when compared to Scotland as a whole, which shows an overall decrease in population in this period. However, it should be noted that the increase in population was not evenly distributed

Table 3.2

Comparison of Population Changes Between the

Tayside Region and Scotland

	Tayside		Scotland	
	Total Population ('000)	Change of Population ('000)	Total Population ('000)	Change of Population ('000)
1971	395.5	1.0	5217.4	-7
1972	396.5	1.1	5210.4	1.3
1973	397.6	3.6	5211.7	4.9
1974	401.2	0.8	5216.6	10.4
1975	402	0.2	5206.2	-1.1
1976	402.2	-0.2	5205.1	-9.5
1977	402	1.0	5195.6	-16.2
1978	402.9	-1.3	5179.4	-12.4
1979	401.7	-2.5	5167	-13.7
1980	399.2	-2.4	5153.3	-3.8

Sources:- Registrar General Scotland Annual Report for 1981, H.M.S.O, 1982.

Scottish Abstract of Statistics, No.11, H.M.S.O, 1982.

among all the districts in Tayside. As shown in table 3.3 only Dundee District has enjoyed an increase of population during 1961-71, while the two other districts were experiencing a decrese. However, during the period 1971-1981 the population in Dundee City district decreased by nearly 9%, while the other two districts were enjoying an increase in population. The reasons may well be first, intra-regional migration from Dundee City to the countryside,

Table 3.3

Tayside Region: Percentage Increase or Decrease

in Population by Districts 1961-1981

	Population			% Increase or Decrease	
	1961	1971	1981	1961-1971	1971-1981
Tayside Region	397,820	397,605	391,846	-0.05	-1.45
Angus District	85,155	84,178	93,038	-1.15	10.53
Dundee District	195,258	197,371	179,674	1.08	-8.97
Perth & Kinross District	117,407	116,056	119,134	-1.15	2.65

Source:- Registrar General for Scotland, Census of Population Tayside Region, 1981. Vol.1, 1982

and second, physical development in Angus and Perth & Kinross Districts which attracted people to these districts.

It is also the case that the birth rate in Tayside has fallen substantially during the past decade, from 5.9 in 1971 to 4.8 in 1979. However, the death rate has remained fairly constant, as was also the case for Scotland as a whole.

Table 3.4 compares the age structure of Tayside with Scotland and other regions. It reveals that the proportion of the working age population i.e. between the ages 16 to 64, in Tayside amounted to 59.5%, which is lower than the Scottish average. The proportion of dependent population i.e. under 16 and over 64/59, which amounted to 40.5% in Tayside, is slightly higher than the Scottish average which amounted to 40.3%. The proportion of working age population

Table 3.4

The Age Structure of Scotland and its

Regions in 1980

	Under 16		16-64 for male 59 for female		64/59 & over	
	'000	%	'000	%	'000	%
Scotland	1217.9	23.63	3075.1	59.57	859.8	16.68
Tayside	88.9	22.2	237.4	59.5	73.1	18.3
Borders	21.1	21.2	57.6	57.89	20.9	21
Central	65.2	24	164.7	60.8	41.4	15.2
Dumfries	32.4	23	84.4	59.2	25.6	17
Fife	80.3	23.6	204.3	60.03	55.7	16.4
Grampian	109	23	283.9	60.3	78.9	16.7
Highlands	47.7	24.9	113.4	59.3	30.2	15.8
Lothian	167.6	22.4	453.9	60.6	127.2	16.2
Strathclyde	588.4	24.4	1436.6	59.4	393.9	16.2
Orkney & Other Islands	4.2	23.2	10.2	56.7	3.6	20.1
Shetland	5.9	26.5	12.9	57.8	3.5	15.7
Western Isles	7.1	23.9	16.1	54.2	6.5	21.8

Source:- Scottish Abstract of Statistics, 1982

in Tayside is higher when compared with the Borders, Dumfries, Highlands, Strathclyde, Orkney, Shetland and the Western Isles. Differences in proportions of working age and dependent population may have significant effects on the regional per capita income. Thus the per capita income in Tayside may be lower, when compared with the Scottish average, due to a comparatively higher proportion

Table 3.5

Age Structure of the Population in Tayside

by Districts 1981

	Total Population	Age 0-19		20.64		65 and over	
		Total	%	Total	%	Total	%
Angus District	92,500	27,100	29.3	50,400	54.5	14,900	16.1
Dundee District	185,600	54,300	29.25	103,200	55.6	28,500	15.3
Perth & Kinross	118,700	33,200	27.96	64,400	54.25	21,000	17.7
Tayside Region	396,800	114,600	28.86	218,000	54.9	64,400	16.2

Source:- Registrar General for Scotland, Census of Population, Tayside Region, 1981, Vol.1, 1982

of dependent people and a lower proportion of working age population.

There are no significant variations in the age structures of the population in the three Tayside districts. However, as shown in Table 3.5, some small differences can be identified in the age structures of the individual districts. Dundee has the highest proportion in the working age group. Perth & Kinross, on the other hand, has the highest proportion in the dependent age groups. The main reasons for this are the nature of Dundee as the principal employment centre, and Perth & Kinross, and Angus as attractive places for living.

According to table 3.6, which illustrates economic characteristics of the population, nearly 9.7% of the male working population in

Table 3.6 Economic Characteristics of Population, Tayside Region 1981.

	Total Aged 16-64	Percentage of Aged 16-64					
		Economically Active				Economically Inactive	
		Total	Full-time	Part-Time	Out of Employment	Total	Full-time Students
Men; (16-64)							
Tayside Region	115,796	90.3	77.7	0.7	11.9	9.7	5.5
Districts							
Angus	27,375	92.1	82.5	0.7	8.9	7.9	4.5
Dundee	54,499	89.8	73.6	0.6	15.6	10.2	5.7
Perth & Kinross	33,922	89.7	80.3	0.9	8.4	10.3	6.0
Female (16-59)							
Tayside Region	109,617	63.6	37.6	19.8	6.6	36.1	5.5
Districts							
Angus	25,403	58.7	34.2	19.4	5.1	41.3	4.6
Dundee	52,214	68.3	39.6	19.9	8.8	31.7	5.6
Perth & Kinross	32,000	60.9	37.0	19.8	4.2	39.1	6.2

Source:- Registrar General for Scotland. Census of Population Tayside Region, 1981, Vol. 1, 1982

Tayside were economically inactive[2] in 1980. Further 11.9% were out of work, so that the total employed male population in Tayside was only 78.4% of total working age male population. The economically inactive proportion in the female population was significantly higher than that of the male population. This is because females in the working age groups tend to give up their jobs for raising families. The proportion of the employed population was 57.5% of the total female working age population. The main characteristics of the female economically active population are first, that a significant proportion of the female working age population is part-time workers. Second, the unemployment rate of the female population is lower than that for the male population. This table also reveals that the proportion of economically active male population in Dundee, which is the main industrial city in the region, is lower than that of Angus, and Perth & Kinross. The percentage of employed population in Dundee is also lower than that of the other two districts and it has the highest unemployment rate when compared with the other two districts. In contrast, the proportion of economically active and employed female population in Dundee district is the highest in the Tayside Region.

One of the striking features of the population trend in the late 1970's is the decrease in the rate of net migration in the Tayside Region. In 1979 the figures of the net migration show a high level which amounted to -5.01 per 1,000 persons. This figure is higher than the Scottish average which amounted to -3.16 per 1,000 persons in the same year. The increase in the negative balance in migration, as shown in table 3.7, implies an increased rate of outwards migration from the region. It is difficult to identify

Table 3.7. Net Migration of Scotland and Tayside Region, Per 1000 Persons, 1971-1979.

	1971	1972	1973	1974	1975	1976	1977	1978	1979
Scotland	-5.29	-2.05	-0.38	-3.64	-0.92	-1.88	-3.14	-2.82	-3.16
Tayside Region	-1.76	1.51	8.72	1.99	1.24	1.99	1.98	-2.24	-5.01

Table 3.8. Net Migration and Unemployment in the Tayside Region during 1971-1979

Year	Net Migration (Thousands)	Unemployment (as a % of total employees)
1971	-0.7	5.6
1972	0.6	6.0
1973	3.5	4.4
1974	0.8	3.1
1975	0.5	3.9
1976	0.8	6.1
1977	0.8	6.9
1978	-0.9	7.0
1979	-2.0	7.2

Sources- Registrar General for Scotland, Annual Report for 1981, H.M.S.O.
Scottish Abstract of Statistics, No.9, 1980. H.M.S.O.

---

2. Economically inactive male population consists of full-time students, disabled and permanantly sick people in the working age groups.

the factors which caused this increase in migration in the late 1970's. However, it is clear that there is some relationship between population movements and the increase in the number of jobs in the early 1970's and the loss of employment in the late 1970's. In 1973, for example, and as shown in table 3.8, the net migration increased positively to the peak level of the decade. The rate of unemployment also fell to 4.4% in 1973 from 6% in 1972.

The hypothesis that there is a close relationship between the level of net migration and the level of unemployment, has been tested statistically using simple linear regression analysis. For this purpose it is assumed that the level of net migration is dependent on the level of unemployment. This analysis showed that the level of outward migration is increasing when the rate of unemployment in the region increases.[3] The test also showed that the correlation coefficient ρ, between net migration and unemployment is 0.5488. This implies that the two variables, net migration and unemployment are significantly correlated. This test also shows that nearly 55% of the reasons for the negative increase in net migration can be explained by the increase in unemployment leaving 45% for other factors. Therefore it may reasonably be concluded that the rate of unemployment in the region has given rise to an increase in the level of emigration. The increase in outwards migration means that the demand for goods in the region is also declining. This indicates a further increase in

3. The regression equation is, $Y = 3.56 - 0.51 X$, where Y = net migration, and X = rate of unemployment during the period of 1971-1979.

unemployment and consequently a reduction in the purchasing power of households. Therefore the increasing level of emigration specifically in the working age group should be taken into account by policy makers concerned with the future development of the Tayside economy.

3.1.3 ANALYSIS OF PRODUCTION IN THE TAYSIDE REGION

3.1.3.1 STRUCTURE OF PRODUCTION

The structure of production in Tayside can be analysed either in terms of gross output or the size of the work force in each production sector. It is difficult to make available the most accurate information for the gross outputs of the region for 1979 and for the previous years. The only source of information available for the analysis of the nature of Tayside industry and its structural changes and recent developments is the statistics of employment. These statistics were obtained from the Department of Employment in Scotland. There were some instances where the statistics were incompatible. The statistics provided for the years before and after 1975 for example, are incompatible because of the changes in the boundaries of Tayside Region. Also the Department of Employment normally does not take small businesses with under 10 employees into account. However, there are considerable numbers of small family businesses in Tayside as listed in the Tayside Engineering and the Manufacturing Resisters. Although the statistics provided by the Department of Employment have been used for the present analysis, care has to be taken in checking the consistency of information and in distinguishing the data for the years before and after 1975.

Table 3.9 illustrates the employment structures of Tayside, Scotland and the U.K. economies in 1978. One of the main features which can be seen from this table is the importance of the primary sector and the service sectors in the Tayside Region when compared to the Scottish average and the national average. The manufacturing sectors, mining and quarrying, and utilities in Tayside employed relatively fewer people when compared to Scotland and the U.K. The construction sector in Tayside had proportionately a higher number of employees when compared to the national average although it was lower than the Scottish average.

The relative importance of Tayside production, in the Scottish and in the U.K. economies, is illustrated in Table 3.10. It shows that agriculture, forestry and fishing in Tayside represents approximately 14% of the total production of this sector in Scotland, while it accounts for nearly 2% of the production of this sector in the U.K. The other sectors in Tayside except mining and quarrying, represent more than 7% of total production of the respective sectors in Scotland in terms of employment.

Further disaggregation of the manufacturing sectors, on the basis of the main list heading of the Standard Industrial Classification (SIC), is set out in table 3.11. It illustrates the importance of the performance of the manufacturing in Tayside when compared to Scotland and the U.K. This table reveals that the traditional industries, such as textiles, are still important within the manufacturing sector of the region. Textiles employed nearly 21% of the labour force in manufacturing in 1978, which was

Table 3.9. Employment in Tayside by Main sectors compared to Scotland and the U.K. in 1978.

(Thousands)

SIC		TAYSIDE		SCOTLAND		U.K.	
		TOTAL	%	TOTAL	%	TOTAL	%
1	Agriculture, Forestry & Fishing	6.658	4.11	48	3.32	387	1.7
11	Mining & Quarrying	0.94	0.58	39	1.89	343	1.51
111-X1X	Manufacturing Industries	45.454	28.06	604	29.22	7298	32.14
XX	Construction	11.87	7.33	160	7.74	1269	5.6
XX1	Gas, Electricity & Water	1.984	1.22	28	1.35	350	1.54
XX11-XX V11	Services	95.049	58.7	1188	57.47	13059	57.51
	TOTAL	161.955	100	2067	100	22706	100

Sources:- Scottish Abstract of Statistics, Vol. 9, 1980
Annual Abstract of Statistics, 1980 Edition
Department of Employment, Scotland.

Table 3.10 Relative Importance of Tayside in Scotland and the U.K. Economies

%

SIC		SCOTLAND	U.K.
1	Agriculture, Forestry & Fishing	13.87	1.72
11	Mining and Quarrying	2.41	0.27
111-X1X	Manufacturing Industries	7.52	1.6
XX	Communication	7.42	0.93
XX1	Utilities	7.08	0.57
XX11-XXV1	Services	8.0	0.73

Source:- Table 3.9

considerably higher than the Scottish and the U.K. averages. Timber and furniture, paper, printing and publishing, and other manufacturing industries also employed a work force which was higher than the Scottish and the U.K. averages. Although the shipbuilding industry in Tayside is less significant compared to the Scottish average, employment in this sector was slightly higher than the U.K. average. This table also reveals that in 1978, there were six sectors namely coal and petroleum producers, instrument engineering, textiles, timber furniture, etc., paper printing and publishing, and other manufacturing industries in Tayside, which together employed nearly 54% of the total manufacturing labour force, and which performed well above the Scottish average in terms of employment.

It can also be seen that there were seven sectors, including five sectors mentioned above, together with food, drink and tobacco and shipbuilding, which have performed better than the national average. Therefore, on this basis, it may be concluded that eight sectors in the Tayside economy, which employed 70% of the total manufacturing labour force, have experienced a rate of growth in employment that was substantially greater than their counterparts elsewhere in the U.K. and Scotland in 1978.

A more precise measure of the structure of Tayside production can be obtained by introducing the concept of location quotients (LQs). When the value of the quotient is greater than one,[4] Tayside has a larger share in the particular industry when compared to the

---

4. See section 2 of Chapter 4 for the method of calculation of LQs.

Scottish economy, and vice versa. The location quotients at both the main order list headings and those of the minimum order list headings have been calculated and these are presented in tables 3.12 and 3.13. In table 3.13, LQs were calculated only for a selected number of minimum list headings, covering manufacturing sectors more fully than other sectors.

Some important findings emerged from table 3.13. It reveals that Tayside has a larger share in 22 industries out of 27 selected from the minimum list headings. These 22 industrial sectors which have LQs greater than one, could be regarded as the most prominent sectors within the Tayside economy. It is clear that this regional specialization could not be derived from the LQs calculated for main list headings of SIC as illustrated in table 3.12 due to the aggregation of sectors. The table 3.13 shows that the Tayside Region is in the forefront in Scotland in terms of specializing not only in traditional industries such as jute, weaving of cotton and fibre, etc. but also in terms of most of the new growth industries such as chemicals and allied industries, scientific instruments, electric machinery and other electrical goods. The Tayside Region has not suffered relative to the rest of Scotland, from the lack of new growth sectors judging by the statistics of employment in 1978.

3.1.3.2 STRUCTURAL CHANGES IN THE TAYSIDE ECONOMY

Table 3.14 indicates the major structural changes in the Tayside economy during the period 1971-1978. It reveals that the primary and manufacturing sectors were contracting over the eight year period. The construction sector experienced some fluctuations in

Table 3 - 11.

Comparison of Employment in Manufacturing Sectors in Tayside, Scotland and the U.K. in 1978

(Thousands)

SIC Order		Tayside Total	Tayside %	Scotland Total	Scotland %	U.K. Total	U.K. %
iii	Food, drinks and tobacco	5.931	13.05	91	15.07	717	9.82
iv	Coal and Petroleum products	0.283	0.63	3	0.5	37	0.51
v	Chemicals and allied industries	1.158	2.55	32	5.3	431	5.9
vi	Metal manufacture	0.574	1.26	37	6.13	459	6.29
vii	Mechanical eng.	4.599	10.12	87	14.4	934	12.8
viii	Instrument eng.	7.077	15.57	16	2.65	149	2.04
ix	Electrical eng.	2.482	5.46	48	7.95	748	10.25
x	Shipbuilding and Marine eng.	1.674	3.68	41	6.79	183	2.51
xi	Vehicles	0.589	1.29	35	5.79	773	10.59
xii	Metal goods not elsewhere specified	1.866	4.1	29	4.8	540	7.4
xiii	Textiles	9.517	20.94	55	9.1	495	6.78
xiv	Leather, leather goods and fur	0.055	0.12			40	0.55
xv	Clothing and footwear	1.394	3.07	34	5.63	383	5.25
xvi	Bricks, pottery, glass and cement etc.	0.694	1.53	17	2.81	268	3.67
xvii	Timber, furniture etc.	1.73	3.81	20	3.31	264	3.62
xviii	Paper, printing and publishing	4.414	9.71	43	7.12	542	7.43
xix	Other manufacturing industries	1.417	3.12	16	2.65	335	4.59
	Total	45.454		604		7298	

Sources: Scottish Abstract of Statistics, 1980
Annual Abstract of Statistics, 1982
Department of Employment, Scotland.

Table 3 - 12

Location Quotients for Tayside Industry, 1978
Main Order List Headings of SIC

		Tayside Total	Tayside %	Scotland Total	Scotland %	L.Q's
i	Agriculture, forestry, fishing.	6,658	4.11	48,000	2.32	1.77
ii	Mining and Quarrying	940	0.58	39,000	1.89	0.3
iii	Food, drink and tobacco	5,931	3.66	91,000	4.4	0.83
iv	Coal and petroleum products	283	0.17	3,000	0.14	1.21
v	Chemical & allied industries	1,158	0.71	32,000	1.55	0.46
vi	Metal manufacture	574	0.35	37,000	1.79	0.19
vii	Mechanical engineering	4,599	2.83	87,000	4.2	0.67
viii	Instrument engineering	7,077	4.37	16,000	0.77	5.67
ix	Electrical engineering	2,482	1.53	48,000	2.32	0.66
x	Shipbuilding and marine engineering	1,674	1.03	41,000	1.98	0.52
xi	Vehicles	589	0.36	35,000	1.69	0.21
xii	Metal goods not elsewhere specified	1,866	1.15	29,000	1.4	0.82
xiii	Textiles	9,517	5.88	55,000	2.66	2.21
xiv	Leather, Leather goods and fur	55	0.03	34,000	1.64	0.54
xv	Clothing and footwear	1,394	0.86			
xvi	Bricks, pottery, glass, cement, etc.	694	0.43	17,000	0.82	0.52
xvii	Timber, furniture, etc.	1,730	1.07	20,000	0.97	1.1
xviii	Paper, Printing & Publishing	4,414	2.72	43,000	2.08	1.3
xix	Other manufacturing industries	1,417	0.87	16,000	0.77	1.12
xx	Construction	11,870	7.33	160,000	7.74	0.95
xxi	Gas, electricity and water	1,984	1.22	28,000	1.35	0.9
xxii	Transport & Communication	8,678	5.36	135,000	6.53	0.82
xxiii	Distributive trades	20,368	12,58	239,000	11,56	1.09
xxiv	Insurance, Banking & Finance	5,474	3.38	78,000	3.77	0.9
xxv	Professional & Scientific services	27,443	16.94	351,000	16.98	1
xxvi	Miscellaneous services	18,793	11.6	241,000	11.66	0.995
xxvii	Public administration & defence	14,293	8.82	144,000	6.97	1.26
	Total	161,958		2,067,000		

Source: Department of Employment, Scotland.

Table 3 - 13.

Location Quotients for Tayside Industry, 1978
Minimum Order of List Headings of SIC

SIC Order	Description	Tayside		Scotland		L.Q's
		Amount of employees	%	Amount of employees	%	
001	Agriculture	6,198	3.83	41,500	2	1.91
003	Fishing	219	0.135	2,100	0.08	1.68
104	Petroleum & natural gas	603	0.372	10,200	0.49	0.76
212	Bread & flour, confectionery	1,074	0.663	11,500	0.55	1.2
214	Bacon, meat & fish products	907	0.56	16,900	0.81	0.69
218	Fruit & vegetable products	997	0.615	5,000	0.24	2.56
262	Mineral oil refining	273	0.168	2,400	0.116	1.45
272	Pharmaceutical chemicals	599	0.37	4,300	0.21	1.76
276	Synthetic resins and plastic materials	398	0.24	3,500	0.169	1.42
331	Agricultural machinery	655	0.4	3,800	0.183	2.18
332	Metal working machine tools	636	0.39	2,800	0.135	2.89
338	Office machinery	1,129	0.7	4,100	0.198	3.53
339	Other machinery	913	0.56	16,300	0.788	0.71
352	Watches and clocks	5,705	3.52	6,500	0.314	11.2
354	Scientific instruments	1,009	0.62	8,300	0.4	1.55
361	Electric machinery	778	0.48	7,200	0.35	1.37
369	Other electrical goods	765	0.47	4,700	0.227	2.07
399	Metal industries	1,175	0.72	16,900	0.82	0.88
413	Weaving of cotton & fibres	801	0.49	2,400	0.116	4.22
415	Jute	5,670	3.5	5,700	0.27	12.96
471	Timber	872	0.538	8,900	0.43	1.25
486 + 485	Printing & publishing of newspapers	2,513	1.55	10,400	0.5	3.1
489	Other printing, publishing	1,264	0.78	12,900	0.62	1.26
491	Rubber	826	0.51	6,500	0.314	1.62
496	Plastic products	570	0.35	4,100	0.198	1.76
602	Electricity	1,150	0.71	18,100	0.875	0.81
708	Postal services & Telecommunications	2,709	1.67	34,000	1.64	1.02

Source: Department of Employment, Scotland.

('000)

Table 3.14 Tayside Employees in Employment 1971-1978

	1971		1972		1973		1974		1975		1978	
	Total	%	Total	%	Total	%	Total	%	Total	%	Total	%
Primary	9.1	5.7	8.8	5.6	8.7	5.4	8.4	5.2	8.4	5.1	7.6	4.7
Manufacturing	52.5	33.2	49.9	31.9	50.1	31.0	52.1	32.1	48.9	29.5	45.4	28.1
Construction	12.4	7.9	11.8	7.6	13.7	8.5	12.9	7.8	13.1	7.9	11.9	7.3
Services	84.2	53.2	85.8	54.9	89.0	55.1	88.9	54.7	95.0	57.4	97.0	59.9
TOTAL	158		156		161		162		165		162	

Source:- Report and Survey 1980, Tayside Structure Plan the rate of employment. The highest level of employment in this sector can be seen in 1973, and ever since, this sector has been releasing its labour force. This indicates that this sector has been unable to continue its importance as a large employer in the region. This is partly because the resources spent on regional house building and house development, road construction and improvements, and other regional physical development, by the private and public sectors, have been declining since 1973 and partly because of use of new technology. This trend might have given rise to contraction in the labour force in other sub-contracting and allied industries such as engineering and electrical goods, building materials and utilities in the region, due to the lower demand created from construction. This is clearly illustrated in table 3.15. When the labour force in construction fell from 8.52% in 1967 to 7.33% in 1978 the aforesaid industries during the same period also experienced a declining trend in employment.

One of the most significant features of the Tayside economic structure is that the service sectors have been expanding almost continuously since 1971, employing more than half of the total labour force in the region. During the period between 1975 and 1978 the Tayside labour force in services increased by 2.5%, in contrast to the decline of employment in the primary, manufacturing and construction sectors as well as in the region as a whole.

The Tayside employment statistics can be disaggregated by sector according to the SIC main order list headings. Tables 3.15 and 3.16 show structural changes in Tayside employment during the period 1951-1978. Table 3.15 illustrates that the number in

Table 3 - 15.

Tayside Employment, 1951 - 1978

SIC Order	1951	1956	1961	1966	1967	1978
Agriculture, Forestry, Fishing	18,400	17,400	16,800	14,000	12,300	6,658
Mining & Quarrying	700	700	600	500	500	940
Total primary	19,100	18,100	17,400	14,500	12,800	7,598
Food, Drink and Tobacco	7,900	7,700	7,200	7,100	7,000	5,931
Chemicals & Allied Industries	1,200	800	800	800	500	1,441
Metal Manufacture	600	1,000	700	600	900	574
Engineering & Electrical goods	11,800	12,800	14,000	17,400	17,600	14,158
Shipbuilding & Marine Eng.	2,500	2,700	1,600	1,200	1,100	1,674
Vehicles	1,000	1,000	800	700	600	589
Metal Goods not elsewhere specified	600	600	900	1,500	900	1,866
Textiles	29,200	27,300	23,900	23,500	20,500	9,517
Leather, Leather goods and fur	300	200	200	100	100	55
Clothing & Footwear	2,200	1,800	1,200	900	900	1,394
Bricks, Pottery, Glass, Cement	600	600	700	800	1,100	694
Timber, Furniture, etc.	2,400	1,900	1,700	1,800	1,800	1,730
Paper, Printing and Publishing	4,300	4,400	4,600	4,900	4,900	4,414
Other Manufacturing Industries	1,900	1,900	1,500	1,200	1,100	1,417
Total Manufacturing	66,500	64,700	59,600	62,500	59,000	45,454
Construction	13,300	14,300	12,900	14,100	14,500	11,870
Gas, Electricity & Water	2,500	2,400	2,600	2,800	2,700	1,984
Transport & Communications	12,000	11,300	10,400	9,100	8,200	8,678
Distributive Trades	18,800	20,300	23,000	22,600	20,600	20,368
Insurance Banking & Finance	3,300	3,200	3,500	3,900	4,700	5,474
Professional & Scientific services.	16,000	17,100	19,500	22,600	23,400	27,443
Miscellaneous services	19,000	17,700	16,300	17,100	15,700	18,793
Public Administration & Defence	9,700	8,600	7,400	7,500	8,500	14,293
Total services	81,300	80,600	82,700	85,600	83,800	97,033
Grand total	180,200	177,700	172,800	176,700	170,100	161,955

Source: Department of Employment, Scotland.

employment declined during 1951-1978 by 60% in the primary sectors, by 32% in manufacturing and by 11% in construction. The numbers in employment in the service sector has increased by 16% during this period. However, it should be noted that the figures given in the table 3.15 for the period 1951-1967 are not consistent with those for 1978 because of changes in the boundaries of the Tayside Region in 1975. Data were not available to distinguish the number of employees in the North of Fife by MLH of the SIC. However, it can be seen that the total number of employees in this area in the 1960's within Tayside's jurisdiction, was in the range of 2,000-3,000 which was less than 2% of Tayside's labour force in 1978.

Table 3.16 expresses the numbers in employment from 1951 to 1978 in Tayside. This facilitates the analysis of Tayside's economic structure in dynamic terms. Thus one can examine the sectors of the Tayside economy which were growing most rapidly and those which were contracting over the last 26 years.

It may be seen that the agricultural sector has been contracting significantly in terms of employment since 1951. The labour force in this sector has been reduced from 10.21% in 1951 to 4.11% in 1978. There has also been a dramatic decline in employment in the textile industry which provided a living for 16% of the Tayside labour force in 1951. In 1978, textiles only employed 6% of the total labour force. Other manufacturing, such as shipbuilding and marine engineering, clothing and footwear, timber and furniture, also declined in terms of employment.

The growth sectors in Tayside which expanded during the period 1951-1978 were chemicals and allied industries, metal manufacturing,

Table 3 - 16.

Tayside Employment, 1951 - 1978

%

SIC Order	1951	1956	1961	1966	1967	1978
Agriculture, Forestry, Fishing	10.2	9.79	9.72	7.92	7.23	4.11
Mining & Quarrying	0.39	0.39	0.35	0.28	0.29	0.58
Total primary	10.59	10.18	10.07	8.2	7.52	4.69
Food, Drink and Tobacco	4.38	4.33	4.17	4.02	4.11	3.66
Chemicals and Allied Industries	0.67	0.45	0.46	0.45	0.29	0.9
Metal Manufacture	0.33	0.56	0.4	0.34	0.53	0.35
Engineering & Electrical goods	6.56	7.2	8.1	9.85	10.35	8.74
Shipbuilding & Marine Eng.	1.39	1.52	0.93	0.68	0.65	1.03
Vehicles	0.55	0.56	0.46	0.4	0.35	0.36
Metal Goods not elsewhere specified	0.33	0.34	0.52	0.85	0.53	1.15
Textiles	16.2	15.36	13.83	13.3	12.05	5.9
Leather, Leather goods and fur	0.17	0.11	0.11	0.06	0.06	0.03
Clothing and Footwear	1.22	1.01	0.7	0.51	0.53	0.86
Bricks, Pottery, Glass, Cement	0.33	0.34	0.4	0.45	0.65	0.43
Timber, Furniture, etc.	1.33	1.07	0.98	1.02	1.06	1.07
Paper, Printing & Publishing	2.39	2.48	2.66	2.77	2.88	2.72
Other Manufacturing Industries	1.05	1.07	0.87	0.68	0.65	0.87
Total Manufacturing	36.90	36.4	34.59	35.38	34.69	28.07
Construction	7.38	8.06	7.46	7.98	8.52	7.33
Gas, Electricity & Water	1.4	1.35	1.51	1.58	1.59	1.22
Transport & Communications	6.66	6.36	6.02	5.15	4.82	5.36
Distributive Trades	10.43	11.42	13.32	12.79	12.11	12.58
Insurance, Banking & Finance	1.83	1.8	2.03	2.21	2.76	3.38
Professional & Scientific Services	8.88	9.62	11.3	12.79	13.76	16.94
Miscellaneous Services	10.54	9.96	9.43	9.68	9.23	11.6
Public Administration & Defence	5.4	4.84	4.28	4.24	5	8.82
Total services	45.14	45.35	47.89	48.44	49.27	59.91
Total number of population	451,200	452,000	452,300	449,800	447,300	402,930
Total employment as a % of population.	39.93	39.31	38.2	39.28	38.03	40.19

Sources: Annual Reports, Registrar General, Scotland.

Department of Employment, Scotland.

engineering and electrical goods, other metal goods, building materials and the service sectors. There was a considerable rate of expansion in almost all of the service sectors. The professional and scientific services, for example, expanded significantly, increasing its labour force by about 71 % between 1951 and 1978.

Table 3.16 also reveals that total employment as a proportion of total population grew from 39.93% to 40.19% during the period between 1951 and 1978. This indicates, as a whole, that employment opportunities in the region increased by 0.26%. This can be compared with an increase in the labour supply. Table 3.17 gives a general idea of the increase in the Tayside labour supply over the period 1971-1981. It reveals that the labour supply rose as a proportion of total population from 56.5% in 1971 to 58.8% in 1981, indicating a 2.3% increase. This clearly suggests that the Tayside economy was unable to create sufficient demand for its labour supply during the past decade.

Structural changes in the Tayside economy can be compared with Scottish and the U.K. averages in order to identify some prominent characteristics of the region. Table 3.18 reveals that many manufacturing sectors in Tayside have been contracting in accordance with the broad pattern of decline in Scotland and the U.K. Agriculture, food and drink, metal products and even some of the new growth sectors, such as electronics, have been declining in line with the trends in Scotland and the U.K. At the same time, some developments in some sectors in the U.K. and Scotland were also visible in the Tayside Region. Chemicals and allied industries, other manufacturing, and metal goods not elsewhere specified, for example, grew in line with the national trends

Table 3.17

Tayside Region: Population by Age

Year	Total Population	Percentage Aged:		
		0-15	16-64	Over 64
1971	397,605	25.9	56.5	22.7
1981	391,846	21.9	58.8	25.8

Source: Registrar General for Scotland, Annual Reports 1975, 1981.

between 1967 and 1978.

This table also reveals some exceptions. There were some sectors in the Tayside Region, which were expanded even when the same sectors in Scotland and the U.K. were contracting; for example, mining and quarrying, shipbuilding, vehicles, timber and furniture, and transport and communication.

However, it should be noted, that there is a paradox between growing productivity and a declining labour force. In some sectors, agriculture in particular, productivity has increased due to the introduction of new technology, so that they could dispense with a part of their labour force. Hence, the decline of agriculture in Tayside, in terms of employment does not mean that its output declined in the 1960s and 1970s. In fact, the output of the agricultural sector has increased and so also has the productivity

Table 3 - 18

Comparison of employment structure of Tayside Region between Scotland and the U.K., 1967 - 1978

%

SIC Order	1967 Tayside	1967 Scotland	1967 U.K.	1978 Tayside	1978 Scotland	1978 U.K.
Agriculture, Forestry, Fishing	7.23	3.2	2.38	4.11	2.32	1.7
Mining & Quarrying	0.29	2.6	2.39	0.58	1.89	1.51
Total primary	7.52	5.8	4.77	4.69	4.21	3.21
Food, Drink and Tobacco	4.11	4.9	3.45	3.66	4.4	3.16
Chemicals & Allied Industries	0.29	1.5	2.13	0.89	1.69	2.06
Metal Manufacture	0.53	2.4	2.62	0.35	1.79	2.02
Engineering & Electrical goods	10.35	8.8	9.09	8.74	7.3	8.06
Shipbuilding & Marine Eng.	0.65	2.3	0.89	1.03	1.98	0.8
Vehicles	0.35	1.9	3.62	0.36	1.69	3.4
Metal Goods not elsewhere specified	0.53	1.2	2.56	1.15	1.4	2.38
Textiles	12.05	4.3	3.08	5.88	2.66	2.18
Leather, leather goods and fur	0.06	0.2	0.23	0.03	1.64)	0.18
Clothing and footwear	0.53	1.5	2.11	0.86	)	1.69
Bricks, Pottery, Glass, Cement	0.65	1.2	1.42	0.43	0.83	1.18
Timber, Furniture, etc.	1.06	1.2	1.21	1.07	0.98	1.16
Paper, Printing & Publishing	2.88	2.7	2.68	2.72	2.08	2.39
Other Manufacturing Industries	0.65	0.8	1.38	0.87	0.78	1.47
Total Manufacturing	34.68	35.0	36.47	28.07	29.22	32.13
Construction	8.52	8.8	6.83	7.33	7.74	5.6
Gas, Electricity & Water	1.59	1.6	1.9	1.22	1.355	1.54
Transport & Communication	4.82	7.3	7.09	5.36	6.53	6.37
Distributive Trades	12.11	12.9	12.25	12.58	11.56	12.04
Insurance, Banking & Finance	2.76	2.2	15.48)	3.38	3.77	21.27)
Professional & Scientific Services	13.76	12.5	)	16.94	16.98	)
Miscellaneous Services	9.23	8.3	8.76	11.6	11.66	10.63
Public Administration & Defence	5	5.7	6.45	8.82	6.97	7.2
Total services	49.26	50.5	51.93	59.9	58.82	59.05

Sources: Department of Employment, Scotland.
Scottish Abstracts of Statistics, 1971, 1979 and 1981
Annual Abstracts of Statistics, 1971, 1979 and 1981.

of the labour force.[5] The other important fact emerging from this situation is that the agricultural sector has responded well to the new technology since the 1950s. On the other hand, in the case of manufacturing industries such as textiles, shipbuilding, etc., the decline in the work force went with a decline in output due to a continuous fall in demand for finished goods attributable to lack of competiveness with other industrial countries, and to the effects of the current international recession.

3.1.3.3 ANALYSIS OF TAYSIDE'S ECONOMIC STRUCTURE BY SECTORS

Attention will be centred in this section on the performance of some of the major sectors in the region. This will enable the identification of the main advantages and disadvantages which have resulted from the economic development of the Tayside Region during the past years.

Agriculture is one of the most successful sectors in Tayside. Mixed farming is a prominent characteristic of this sector. It includes the production of cereal, cash and fodder crops, and dairy farming. Most of the specialised farming takes place in the lowlands. The lowlands of Tayside enjoy a low rainfall, extensive duration of sunshine and productive soils. They normally benefit from freedom from late spring frosts. These advantages have helped the concentration of potato, soft fruits (raspberries and

---

5. Department of Scotland Agriculture and Fisheries. "Economic Report on Scottish Agriculture" 1980.

strawberries, blackcurrants) and market garden products such as tomatoes, peas and carrots. The potato production has become a regional speciality, and Tayside accounts for nearly 50% of Scotland's potato production.

The Tayside Region has 90% of Scotland's raspberry acreage, with an annual production of about 10,000 tons. Nearly 90% of fruit production goes to canneries and jam factories in Dundee, Blairgowrie, Forfar, Montrose, Carnoustie and Arbroath. The rearing of pedigree livestock is another characteristic of farming in Tayside. There are annual bull sales in Perth, in which almost every region of Scotland takes part.

In the past, the fishing industry played a significant role in the Tayside economy. The number of persons employed in it has been declining, partly because of the introduction of new technology, and partly because of the competition from foreign vessels. However, as shown in table 3.12, the proportionate share of fishing in Tayside, in terms of employment, is higher than the Scottish average. This indicates fishing still plays a prominent role in Tayside when compared to the other parts of Scotland. Therefore it may reasonably be concluded that the fishing industry should be given attention in the future industrial expansion programmes for the Tayside Region.

Textiles has made up a large part of the traditional base of the Tayside economy. In terms of employment, about 90% of the British jute industry belongs to Tayside. The jute industry employed 60% of the workforce in the textile sectors in the Region in 1978. As a whole, textiles accounted for 21% of the total manufacturing employment in the region in 1978. There are also many jobs indirectly associated with textiles. Transport and dock workers, who carry finished goods and inputs to and from factories are dependent on the region's textile industry. Also, textile plants need regular servicing and machine tools, spare parts and other accessories. There are many engineering firms located in Tayside to give engineering services to the textile industry. Therefore, the textile industry generated many millions of pounds directly and indirectly in the region in 1978.

However, the fact that the jute industry in Tayside has been collapsing since the Second World War is well known.[6] The main reasons for this, which emerged in the present study, is the fact that the region has no locational advantages in terms of having natural resources i.e. jute; but it localised in Tayside specifically during the late 19th and early 20th centuries, because of enterprising local people. There have been, and still are, trade relationships with the jute producing areas in the world in particular, India and Bangladesh. As colonies of Britain they could supply all the jute requirements to the textile factories in Tayside at cheap rates. After independence, this situation changed because these countries entered the world market so that they could sell their jute at competitive prices to other countries as well. Consequently, the price of jute increased and

---

6. McDowall, S and Draper, P. Trade Adjustments and the British Jute Industry, Fraser of Allander Institute, Glasgow, 1978.

   Howe, W.S., The Dundee Textiles Industry, 1960-1977, Aberdeen University Press, 1982.

many textile manufacturers in Tayside had to face higher production costs against low prices for finished goods.

Since the late 1960s polypropylene resin has been introduced to textiles in place of jute. In terms of growth, the output of the polypropylene textile industry rose by an average 10% a year in the 1970s. In 1978, its production reached a near record level.[7] This suggests that the textile industry in Tayside has responded well by adopting new technology. McDowall commented, "It seems that the polypropylene producers could eliminate jute from almost all its traditional markets by the adoption of the appropriate pricing policy".[8] This implies that there are positive hopes concerning the ability of polypropylene to overtake the jute industry in Tayside in future. Therefore, the newcomer to the industry is responsible for its survival to a certain degreee.

However, the change in technology to polypropylene gave rise to some unfavourable results to the Tayside economy. Unlike jute, polypropylene is less labour intensive in production. This means it needs about one-sixth of the labour required for jute to produce the same output of finished goods. Consequently, polypropylene producers have to release part of their workforce. This partly explains the dramatic decline of the labour force in this sector.

---

7. Special Industrial Correspondent, Dundee Courier, 23.5.79.
8. McDowall, S. Trade Adjustments and the British Jute Industry Page 22.

The statistics on employment for the recent past indicates that the total labour force in this sector fell from 12% in 1967 to 5.8% in 1978, representing a 55% decline over the eleven year period. Therefore, it is clear that the textile industry may no longer dominate the Tayside economy as a major employer.

The engineering industry has taken the place of textiles in the Tayside economy since the Second World War. There are about 200 engineering companies registered with the Tayside Region Industrial Office. They include large-scale world famous industries and also small-scale family businesses and sub-contractors. As a whole, the engineering industry in Tayside employed 8.7% of total labour force in 1978 which was greater than that in the textile industry. This rate is still slightly lower than the Scottish and the U.K. averages. (See table 3.18).

Engineering in Tayside can be classified into four sub-divisions for the purpose of analysis, namely precision engineering, agricultural engineering, new engineering growth industries, such as electronics, and oil-related engineering industries.

Precision engineering industry is playing an important part in the Tayside economy, employing approximately 16% of the total manufacturing work force in 1978. It was originally designed to service the declining textile industry in the post war period. In this period multi-national companies such as Timex, N.C.R., Veeder Root, Holo Krome and Interplex formed subsiduaries in Tayside. Their production lines varied from assembling watches to the production of machinery components, machine tools, and cash registers. These large companies provide more than 60% of the total employment in this sector. Timex, for example, employed about 5,500 people, of whom 3,600 were female, until late 1982. N.C.R., which is one of the major technical organisations in Tayside, employed nearly 1,050 production and engineering staff in 1979.

The main characteristics of Tayside's agricultural engineering is the variety of small agricultural engineering firms. Some of these are continuing to increase their number of employees, while some other companies in this sector have diversified in order to provide services to other fields in engineering.

However, as shown in the section 3.1.3.2, employment in engineering has also been in decline since the late 1970s. During this period, new lines, in particular electronics and North Sea oil-related engineering, entered into the engineering sector in the Tayside Region. The existing skills in the field of precision engineering gave rise to a new electronic industry in the Tayside economy. These skills, together with the continuing spending on research and development work, have helped N.C.R to make electronic products such as self-service banking terminals, automatic cheque reader/ sorters and Timex to make three dimensional cameras and home computers.

The other new growth sector in the region, developed since the early 1970s, is the oil related engineering industry. The region has two main oil based towns, Dundee and Montrose. Because of the advantages of the region's North Sea coast line, Tayside companies have been able to offer a whole range of oil field products and engineering services, such as module fabrication, pumping and drilling tools, pipe handling, testing and safety equipment, communication equipment, and repair work. The involvement of Tayside Region in the North Sea oil industry started in late 1971, when the British Petroleum company decided to establish their main North Sea base in Dundee.

Since 1971, the oil fields specifically Forties, have been serviced from Dundee. Since 1972, the Queen Elizabeth Wharf in Dundee has shipped supplies and materials to feed rigs and platforms in the Forties field in the North Sea. Currently, the Forties field produces more than half a million barrels of oil per day. It is one of the major contributors to the U.K's flow of oil from the North Sea.

After B.P., there followed the arrival of another major oil company, Conoco. This company has continued to support a supply centre, for the Murchison oil field. Other Tayside companies which have been actively involved in the North Sea Oil industry are Otis Pressure Control, Drexel Equipment (U.K.) Ltd., and Kestrel Marine Group Ltd. The work of Kestrel Marine which has a work force of 600 in Dundee involves mainly the building and seafastening of topsides for drilling platforms in the Morecambe oil field. They have also done fabrication work for a part of B.P's Magnus field.

Given a brief account of the structure of the North Sea oil related industry, the question may be raised about the way in which this industry has been able to contribute to the region's economy. One of the main factors is the number in employment generated by the oil-related work in Tayside. Table 3.19 shows employment in companies of Tayside Region and Scotland which are directly and wholly related to the North Sea oil industry. This table reveals

Table 3.19

Tayside Region and Scotland: Employment in Companies Wholly Related to North Sea Oil Industry. 1974-1979

(Thousands)

	1974	1975	1976	1977	1978	1979
Tayside Region	0.27	1.1	1.44	1.76	2.05	2.32
Scotland	13.47	20.05	27.1	28.63	23.99	44.76

Source: Scottish Abstract of Statistics. No.11 1982

that the total number in employment in oil related industries in Tayside has increased by 126% between 1974 and 1979, which is higher than the Scottish average of nearly 39% during the same period.

There are a number of other companies in Tayside which are providing services indirectly to the North Sea oil industry. In many cases they give secondary services to the companies which are diversifying their main product lines. The Sidlaw Group, for example, which was a leading textile manufacturer in the region, provides engineering services to the North Sea Oil industry. This accounted for 20.6% of the total output of the Sidlaw Group in 1979. However, it was not possible to obtain the accurate data for this study needed to quantify the indirect labour in Tayside involved with the North Sea Oil industry.

The work on North Sea Oil has also been beneficial to Tayside's expansion of its port facilities and the development of its road transport network. The growth of oil related industries has meant increasing sea and road traffic. This implies development of harbour facilities and road transport. Since the start of the oil-related activities in 1971, 1,500 feet of new quay have been added to the port facilities of Tayside. These consist of 860 feet of Princess Alexandra Wharf, 240 feet of Camperdown dock, and 400 feet of Prince Charles Wharf of Kestrel Marine. Another capital investment, costing abour £250,000, for a new Pilot cutter has been made to facilitate the operation of a great variety of oil related craft which call at the Dundee port.[9] The Tayside Regional Council has also undertaken development of a dual carriageway road transport network, which facilitates the improvement of the relationships of Tayside with the North of Scotland oil based centres.

3.1.3.4 PRINCIPAL FEATURES AFFECTING TAYSIDE INDUSTRY

Some Favourable Factors

The Tayside Region has many locational advantages which are favourable to industrial development. It has easy access by road, rail, sea and air to and from other parts of Scotland and the U.K. A dual carriageway trunk road system links Dundee to Scotland's national motorway network. Tayside has its own airfield, roll-on, roll-off cargo handling facilities and main British Rail links with South and North.

During the past years the training establishments such as Dundee

---

9. This was gathered from a discussion with the Chairman of Dundee Port Authority, Dundee.

University, the College of Technology, Kingsway Technical College, produce between 10% and 25% of the Scottish output of technicians, senior technicians, electrical and electronic engineers, and computing personnel.[10] The female labour force with skills in assembly work, has been an advantage in attracting subsiduaries of multi-national companies to the region. When compared with Scotland and the U.K., Tayside also has a less expensive work force.

The living environment in Tayside has been valued highly by the Tayside Regional Council and the cost of living is lower than other regions in the U.K. British Telecommunication in Dundee is providing a service with modern technology. It has expanded its activities, and links have been programmed for total modernization and extension with "System X". Its activities are well ahead when compared to the other industrial centres in the U.K.[11]

One of the factors most favourable for the regional industry in 1979 was the variety of regional assistance provided by central government. (This factor is discussed further in a later section)

Some Unfavourable Factors

Tayside is short of both land and premises for industrial development. The most suitable premises for industries are in the Tayside

---

10. Tayside Industrial Office. Dundee Project, 1982.

11. These factors were gathered from a discussion with the Assistant General Manager, British Telecommunication in Dundee.

lowlands where agriculture production is most successfully established. Therefore, any expansion programmes for manufacturing especially in Dundee and Angus Districts, might have a significant impact upon the existing agricultural production.

On the other hand, it is clear that the sites and factories which could have top priority in any expansion programme have already been used. One way to deal with this problem could be to use abandoned factories and their premises where there are already infra-structure facilities available. The provision of sewers and water supply to new sites for both housing and industry is said to be extremely expensive. The capital allocation needed, set by the government for this purpose, is insufficient according to the Annual Accounts of Tayside Regional Council for 1979.

The interviews conducted for the present study suggested that rate increases by the local government have a considerable negative impact on local industries. It was said that the "additional charges on Tayside businesses are greater than those faced by their competitors elsewhere in Scotland".[12] The most severe consequence of the rate increases is the difficulty they cause for the survival of some businesses. This is because any increases in costs which cannot be recovered from increasing either selling price or productivity puts the businesses in danger. Therefore, if the pressure of high cost is too severe, it may cause the closure of businesses. The rates outside Dundee, the main city of Tayside, are considerably lower than the main city. In this case,

---

12. Dundee and Tayside Chamber of Commerce and Industry, Dundee Tayside, Vol.24, No.1, 1985, p.465.

further increase in rates may force the firms in the city to move out of the city region. Also, businesses which have their expansion programmes may not be able to continue given the rising rates and other taxes.

3.1.3.5 THE IMPACT OF INDUSTRIAL DECLINE ON THE REGIONAL ECONOMY

The decline of industry has had negative effects on the regional economy. A disturbed labour market due to higher level of unemployment, net outward migration, a comparatively lower level of gross earnings, and labour disputes are some of the problems associated with the declining industries.

The figures of unemployment compared to the U.K. and Scottish averages are given in table 3.20. This table shows that the rate of unemployment in Tayside between 1973 and 1979, was lower than the Scottish average; but it is higher than the national average. One of the main features of the Tayside economy for many years has been a level of unemployment substantially higher than the national average. However, as shown in Table 3.6, this problem has most severely affected the Dundee District, and a few towns in the Angus district such as Arbroath.

Unemployment can be explained as a disturbance of the free operation of the labour market. The supply of labour is higher than the demand and consequently wage levels tend to fall. The lower levels of weekly earnings in Tayside Region, when compared to the Scottish and U.K. averages, are illustrated in table 3.21. During the period 1975-1980, the gross weekly earnings of the

Table 3.20

Unemployment in Tayside, Scotland and the U.K. 1973 - 1979

(%)

	1973	1974	1975	1976	1977	1978	1979
Tayside Region	4.1	3.0	4.0	6.1	7.4	7.4	7.9
Scotland	4.3	3.6	4.6	6.5	8.3	8.3	8.1
U.K.	2.6	2.6	4.1	5.4	5.8	5.7	5.3

Sources: The Scottish Abstract of Statistics, No.11, 1982

Regional Trends 1982. Central Statistical Office, H.M.S.O., 1982

male and female work force were considerably lower than those of Scotland and the U.K., and this means that the long term unemployment has disturbed the determination of an optimal wage rate for Tayside labour.

The relatively low wage level implies a low level of purchasing power, and may depress the level of effective demand. The lower demand can have a decisive impact upon the survival of local businesses. However, a proper analysis of this subject needs an examination of the structure of unemployment by industrial sectors and wage rates, which is outwith the scope of the present study.

Outward migration is one of the striking features resulting from the decline of industry in the Tayside Region. The hypothesis examined in section 3.1.2, has suggested that there is a close relationship between the rate of emigration and the rate of

Table 3 - 21.

Average Weekly Earnings of Manual and All Employees, 1968, 1977 - 1980.

	Manual £					Manual and Non-manual £				
	1968	1977	1978	1979	1980	1968	1977	1978	1979	1980
Tayside Region										
Male	20.9	66.2	69.7	82.5	98.2	23.4	72.6	79.7	91	109.3
Female	10.3	40.8	49.5	54.2	65.4	12.9	49.1	54.3	58.9	67.6
Scotland										
Male	22.1	72.5	81.4	93.6	112.2	24.2	78.3	88.5	101.2	123.1
Female	10.6	43.7	50.2	54.3	66.3	13.0	48.9	54.6	60.4	74.7
Great Britain										
Male	23.1	71.5	80.7	93	111.7	25.6	78.6	89.1	101.4	124.5
Female	11.2	43.7	49.4	55.2	68	13.6	51	56.4	63	78.8

Source: Scottish Abstracts of Statistics, 1971, 1981.

unemployment. The higher rate of outward migration implies lower demand for the goods and services provided by local industries. This give rise to a reduction in output which leads to further contraction of local industries. Therefore, it is clear that the higher levels of unemployment, higher outward migration and the low level of earnings have been the impacts of declining industry upon the Tayside economy. They produce chain reactions unless the pattern is broken by adopting an effective development strategy.

There was some labour unrest in major companies in the Tayside Region particularly during the period from 1980 to 1983. Most of the labour disputes centred not on demands for higher wages but on the fear of redundancies and unemployment. One of the largest disputes in the Tayside industrial history, took place in late 1982 and early 1983, when the Timex work force attempted to save their jobs. This implies that the industrial harmony of Tayside, particularly since 1979, has been changing. Even the growth sectors could not absorb the work force released from the declining manufacturing industries. Table 3.22 for example, shows employment lost in manufacturing in 1981/82. It illustrates, clearly, that not only traditional sectors such as textiles, but also growth sectors in engineering have lost their labour force. This sector, including mechanical, instrument and electrical, has accounted for 23% of the total jobs lost during 1981/82, and 6% of the total labour employed in engineering sector in 1978. The textile industry has lost another 12% of its total labour force during 1981/82. As a whole, in 1981/82, nearly 2.5% of the Tayside labour force joined the national unemployed work force.

The Tayside Region has been dealing with this crisis by bringing

Table 3 - 22

Tayside Region: Employment lost in the Manufacturing Industries, 1981/1982

SIC		Dundee City No. of Co's.	Dundee City No. of Jobs Lost	Angus No. of Co's	Angus No. of Jobs Lost	Perth & Kinross No. of Co's	Perth & Kinross No. of Jobs Lost	Total Jobs lost in Taysid
iii	Food, drink & tobacco	5	215	7	53	12	222	490
iv	Coal & Petroleum products	-	-	-	-	-	-	-
v	Chemical & Allied products	1	15	-	-	-	-	15
vi	Metal Manufacturing	2	77	2	4	1	6	87
vii	Mechanical eng.	10	158	8	224	3	13	395
viii	Instrument eng.	2	401	-	-	2	2	403
ix	Electrical eng.	2	22	1	1	3	65	88
x	Shipbuilding & marine eng.	1	436	3	11	-	-	447
xi	Vehicles	3	4	1	2	3	14	20
xii	Metal goods not elsewhere specified	4	22	7	22	3	12	56
xiii	Textiles	11	484	5	213	6	475	1172
xv	Clothing & Footwear	-	-	3	159	3	6	165
xvi	Bricks, Pottery, Glass, Cement	1	4	1	3	5	98	105
xvii	Timber, furniture etc.	6	95	2	21	8	32	148
xviii	Paper, Printing & Publishing	18	156	7	57	9	43	256
xix	Other Manufacturing Industries	3	3	2	3	-	-	6
	Total	69	2092	49	773	58	988	3853

Source: Unpublished data from Tayside Planning Department, Tayside Regional Council.

about two major structural changes into the economy, namely diversification and attraction of new industries. Many sectors, such as textiles, engineering and agriculture have been subject to diversification. Many textile companies have diversified into multi-products or multi-services. The Sidlaw Group, for example, has diversified its production during the 1970s into two new lines, namely the distribution of hardware and servicing of North Sea Oil and gas exploration and production. The role of textiles in the company performance of Sidlaw, fell to 68% in 1979, in terms of total turn over.

The agricultural sector is also pursuing a diversification strategy. Their latest crop is an oil seed, rape, which is mainly used for the production of cattle feed. On the other hand, most of the manufacturing sectors have been diversified into new growth industries such as electronics, North of Scotland oil related industries, and the production of electrical goods. Low and Bonar PLC, for example, has diversified its old product line into the production of electric transformers over and above their other work with textiles and packaging products. Timex has diversified from its watch making in to sophisticated computer production and three dimensional cameras in early 1980s. However, whether this industrial strategy could produce a positive outcome to the Tayside economy in terms of creating more employment opportunities or increasing regional income cannot be assessed due to lack of data and is outwith the scope of the present study.[13]

13. See for details Howe, W.S. The Dundee Jute Industry: An Economic Organisation Study. Ph.D Thesis, Dundee College of Technology, 1982.

3.2 REGIONAL PLANNING AND THE TAYSIDE ECONOMY

Regional planning in Tayside in its present form, ie, the preparation of structure plans for the whole region and local plans, began in 1977. The Structure Plan is a document in which local government's aims, objectives, policies and strategies for the future economic and physical development of the region are indicated. The Tayside Regional Council received formally in 1975 the responsibility for the preparation and implementation of the Structure Plan for its area covered by the three District Councils.

The Tayside Regional Council was established as a result of the reorganisation of local government in 1975, under the Local Government (Scotland) Act of 1973. In 1975, the county of the City of Dundee and the other three County Councils of Angus, Perth and Kinross, 16 burghs and one water board were amalgamated to form the Tayside Regional Council and three other District Councils. The functions and the staff of these bodies were reallocated accordingly. The functions of Tayside Regional Council are education, social work, the police and fire services, roads and transportation, water and sewerage, and other services which include regional planning. The functions of the District Councils are housing, building control, libraries, environmental health, refuse collection and disposal, food hygiene and other services.

The Regional Council and the District Councils are supposed to work closely together in certain functions. Physical planning, for example, is a function in which both parties are involved. When the Regional Council prepares structure plans, the District Councils are supposed to assist the Regional Council in preparing the local plans. The District Councils are responsible for tourism and recreation facilities in Tayside. The Regional Council is also involved in operating the same activities. It is also seen, except in tourism, recreation and other minor services, in other functions such as assisting the Regional Council in preparing the structure plan, the cooperation between the two bodies is usually limited. These limitations on cooperation is particularly noticeable when the Tayside Regional Council and District Councils are governed by different political parties. However, these two bodies are working jointly in some tasks, especially in attracting new industries and in promoting the regional industries both locally and outside the region.

The Tayside Region consists of 46 regional electoral divisions. Each regional division elects one councillor. Each regional division is divided into two district electorates and each electorate elects one district councillor. Therefore, every ratepayer in the region has a regional councillor and a district councillor representing him on two separate local bodies.

3.2.1 THE STRUCTURE PLAN AND ITS ROLE IN THE TAYSIDE ECONOMY

The Tayside Regional Council set up the Tayside Planning Department (TPD) in order to carry out its function of preparing and implementing the structure plans. The main functions of the TPD, as recommended by the Royal Commission on Local Government (Scotland) in 1969, are intelligence, economic planning, land use planning and implementing services. In order to fulfil these assignments, the TPD set up four sections, namely, Information, Planning Policy, Structure Plans, and the Tayside Regional Industrial Office.

The first stage of the structure plan is to collect information on the economic structure and on land use. The Information Section collects these data and acts as a bank of information. Its services are available mainly for the Structure Plan Section, and other sections of the TPD and the Tayside Regional Council. The Information Section also provides information for other agencies which are involved in planning in the region.

The Planning Policy Section is involved in producing policies and policy options. These policies have to be derived from the objectives of the Tayside Regional Council and they must be in line with national policies. This means that the Planning Policy Section consults every department of the Tayside Regional Council before designing policies. The main function of the Planning Policy Section is to assist the implementation of the major investment programmes of the Regional Council in accordance with its stated policies. On some occasions, the Planning Policy Section is in difficulty in carrying out national policies. It is clear that there have been some contradictions between the regional and national policies. The national agricultural policy, for example, is to give first priority to the agricultural production in the land use planning.

However, according to the needs of Tayside for the development of industry, land required for the industrial expansion sometimes has to be found at the cost of productive agricultural land. In such circumstances, regional policies are more likely to be tied to the regional requirements. The Planning Policy Section also examines the policies of other agencies, such as the EEC and the District Councils in order to achieve compatibility.

The main function of the Structure Plan Section of the TPD is to undertake the preparation of the Structure Plan for the Tayside Region. Other sections of the TPD work jointly with the Structure Plan Section to this end. It is intended that the local plans will be produced by the District Councils before the final preparation of the structure plan. The Structure Planning Section helps to produce the local plans. Several departments of the Regional Council, the Water Services, Roads, Transport, and Education in particular, are closely involved with the Structure Planning Section at several stages in the preparation of the final Structure Plan. The strategies needed for achieving the proposed aims and objectives of the plan are determined in consultation between the Tayside Regional Council and the District Councils.

Finally, the preparation of the structure plans can be outlined as follows: first the preparation of forecasts of how the economy, as a whole, is likely to evolve in terms of population and employment. Second, on the basis of the information provided by the Information Section, aims, objectives and policies are derived. The decline in manufacturing which causes reduced levels of employment and regional income, has been given priority in deriving policies and strategies in the recent structure plans. The third stage is the preparation of draft strategies and the proposed financial plan required for major projects in order to implement the strategies.

After completion of the final structure plan, the Tayside Regional Council submits it to the Secretary of State for Scotland for approval. At the same time copies of the plan are lodged with the principal offices of the four local authorities in Tayside for the public. Members of the public are asked to send any comments to the Secretary of State for Scotland. He examines any objections and suggestions and may approve the structure plan with or without modifications. The strategies proposed in the Tayside Region Structure Plan are then incorporated into policies and strategies for the whole of Scotland.

The main characteristics of Tayside's regional planning, within the context of Scotland as one of the principal regions in the national government is its limited power in the implementation of strategies, designed for removing the constraints on regional growth. The Regional Council has experienced, during the past few years, the limitations imposed by the Secretary of State on levels of public expenditure. The expenditure required by local government does not come entirely from the region. On average over half of the expenditure is covered by central government grants. In turn central government departments also have considerable control over the decisions taken by local government. The most important constraint on local expenditure is the availability of central funds and permission from the central government to borrow. The limitations of financial resources available for the Tayside Regional Council have given rise to increases in the rates. The increase in rates has affected the growth of the economy[14]. Therefore in spite of the various development strategies proposed

---

[14] See Section 3.1.3.4

by the Tayside Structure Plans during the late 1970s it can be seen clearly from the statistics given in tables 3.16 and 3.18, the rates of unemployment and the closures of private companies have been increasing continuously.

The key role in the implementation of planned policies is played by the Tayside Region Industrial Office (TRIO) of the Tayside Planning Department. From the point of view of policies directed towards regional economic development, TRIO provides a service with regard to new investments and expansion of businesses in the region. This service involves providing advice and investment assistance as approved by the Secretary of State for businesses in the region, and conducting marketing programmes for the promotion of business opportunities.

The investment assistance programme provided by the central government takes two forms, first, assistance and promotion at company level, and second, financial assistance for the region as a whole. Under this programme, Dundee and Arbroath have been given "Special Development Areas" status. In this, maximum regional incentives are available for investors in these two areas. The direct government assistance available in Tayside to encourage investment includes Regional Development Grants and Regional Selective Assistance. There are also tax incentives, which allow some firms to avoid paying Corporation Taxes, and another series of schemes to encourage research and development into new products and production processes.

TRIO, acting on behalf of the Tayside Regional Council, gives some assistance to help local industry and commerce. These assistance programmes include the Tayside Business Loans and Grants Scheme, the aim of which is to extend the present provision of assistance to small businesses, the Employment Recruitment Scheme, and the Employment Generation Programme.

TRIO also plays an important role in providing information and undertaking various marketing programmes. It maintains business registers, such as the Tayside Engineering Register, Tayside Manufacturers Register, etc, which are useful in the market for sub-contracting work. In promoting the marketability of the products of small and medium sized companies, it follows the "Tayside Umbrella" approach. This means that TRIO makes arrangements for local businesses to take part in trade exhibitions, which help to promote their products. TRIO also undertakes business trips overseas to attract new investments to the Region and to extend export opportunities.

The District Councils also play an important role in improving the region's industrial image, especially in providing sites, and some infra-structure facilities. Therefore it may be concluded that the local authorities in Tayside can contribute to the economic development in the region given adequate powers and resources in order to implement policies which are geared to the particular needs and requirements of the local areas.

CHAPTER 4

SIMULATION TECHNIQUES FOR CONSTRUCTING INPUT-OUTPUT TABLES FOR THE TAYSIDE ECONOMY

INTRODUCTION

When the input-output model is used in regional planning the main question that planners may raise is, how these tables can be constructed given constraints of time and finance. The survey method, which is undoubtedly the most appropriate way of constructing input-output tables, has not received much attention from regional planners. The main reason is that the regional planners often cannot afford the cost and time needed to conduct surveys and process a large amount of data. Therefore, since the early development of the work in input-output analysis for application in regional planning researchers have focused their attention on exploring simulation techniques which need national input-output tables together with a limited amount of regional information. In this chapter previous work on simulation techniques will be analysed so that an assessment can be made of techniques which are less expensive; but feasible in meeting the needs of regional planners.

4.1. NON-SURVEY SIMULATION TECHNIQUES

In the 1950's and 1960's, and again in the 1980's researchers have carried out work on deriving non-survey simulation techniques for the use of input-output models. Their attention has centred on two alternative methods. Firstly, there has been the application of national technical co-efficients for regional input-output tables and second, mechanical adjustments for the national table so as to obtain the regional input-output tables.

4.1.1. APPLICATION OF NATIONAL COEFFICIENTS

Three assumptions have been made in using national coefficients for the construction of regional input-output tables. First, it was assumed that the national technical coefficients are identical with those applicable to particular regions. The second assumption was that locally-produced goods and services have a definite locational advantage. This means that the input requirements will be met from locally produced goods to the extent that the local output is sufficient. When the regional producers are unable to meet the regional needs then the local firms will import the rest of the requirement of inputs. Third, it was assumed that the proportion of goods distributed to the final demand sectors in the nation is also applicable to the regions.

Based on these assumptions, input-output tables for two regions in the U.S.A., namely New England[1] and Utah[2] were produced in 1953 and 1955 respectively. In the New England input-output tables, Isard estimated the regional outputs for each sector and these were multiplied by the national input coefficients to obtain the regional technical coefficients. In the final balancing of the totals of rows and columns, it was assumed that when the sums of the rows were greater than the regional output, the region was a net exporter. A negative balance in the rows indicated that the region was a net importer.

---

1. Isard, W. "Regional Commodity Balances and Interregional Commodity Flows", American Economic Review, XL11, 1953, pp.167-180.

2. Peterson, W. Moore, F. "Regional Analysis: An inter-industry Model for Utah", The Review of Economics and Statistics, Vol.37, 1955, pp.363-383.

The same methodology, based on the same assumptions, was followed by Peterson and Moore (1955) when they constructed input-output tables for Utah. They assumed that the input coefficients for the nation were identical with those applicable to the region. Control totals for the gross outputs of each industrial sector were obtained by using direct and indirect procedures. When the data on cost structure were not available for filling the structural matrix, national input-output coefficients were used as a first approximation. In estimating the final demand sectors, they assumed that the proportion of final demand to the gross outputs of national input-output tables were applicable for the regional input-output tables.

According to their terminology, Peterson & Moore have constructed a total flow matrix which shows Utah-to-Utah flows with the linkages between Utah and the rest of the nation. This means the cells of the structural matrix indicate the amount of inputs required from the Utah producers as well as from producers outside the Utah region. However when the total distribution of row i is greater than the estimated gross output of row i, they have suggested that the particular industrial sector cannot satisfy local demand and therefore it needs to allow other regional sectors to import. The difference was substracted proportionately from the row of sector i. The reduced amount was then added to a separate sector, namely imports.

It is clear that the methodology of Peterson & Moore has given rise to some contradiction between their written interpretation and the process of constructing input-output tables. This was primarily because the input coefficients that they have estimated for Utah could neither indicate the sectoral production functions nor the inter-sectoral trade relationships.

The use of national input coefficients for the regional input-output tables is generally subject to two main criticisms. First, there are considerable differences between the composition of regional and national industrial structures. Second, it is clear that there are discrepancies between the regional and the national production technology. The sectors in which the regional economy is highly specialised due to locational advantages, often use different production processes when compared to those which are used outside their regions. Therefore regional input coefficients cannot be estimated meaningfully without proper examination of industrial structures.

4.1.2. MECHANICAL ADJUSTMENTS TO THE NATIONAL INPUT-OUTPUT TABLE

The second method of constructing regional input-output tables without using a survey element is to introduce mechanical adjustments to the national input-output tables. The regional input-output tables so obtained are dependent upon three main assumptions. First, it is assumed that the locational factors determine the trading patterns and the technical characters of the industries in the region. This implies that the local trade is maximised, which means that the regional firms will buy from a local supplier to the greatest extent possible. The second assumption is that the regional trade coefficients differ from the national technical coefficients because of the relative importance of the regional import coefficients. Finally, it is assumed that the national pattern of distribution of sales into the final demand sectors, and the pattern of purchase of primary imports are applicable to those of the region.

There are three kinds of mechanical adjustments discussed in the literature. The first can be categorised under the "Simple Location Quotient" (SLQ) simulation method, which can be defined as follows;

$$SLQ = \frac{E_i^r / E^r}{E_i^n / E^n}$$

where E_i^r = number of employees in the sector i of the region

E^r = number of employees in the region

E_i^n = number of employees in the sector i of the nation

E^n = number of employees in the nation.

This method tries to measure the regional specialization of industries relative to the nation in terms of employment.[3] When the SLQ is greater than one, it indicates that the industry obtains locational advantages from being in the region. It also implies that the regional output exceeds the needs of local industries and therefore this industry could export their surpluses. When the SLQ is less than one, it shows that an industry has no regional specialization, so that other local industries need to import certain amounts of their requirements of inputs.

---

3. SLQs can be measured in terms of gross outputs. However in the absence of accurate data on outputs of industrial sectors in Scotland for the year 1979, employment figures were used to obtain the SLQs.

One of the main characteristics of this model is that the domestic flow coefficients of the region cannot be larger than the national technical coefficients. This gives rise to a somewhat contradictory situation because of the assumption on which this model is based i.e. that the regional trade coefficients may differ from that of the nation. When the LQ's are greater than one there is no way to distinguish this regional specialization in the model. Instead, it assumes, when LQ $\geq$ 1, that the national technical coefficients could be used as regional domestic flow coefficients.

On the other hand the assumption which relates to the commodity cross-hauling of the industries cannot, in practice, be applied to the regional industrial sectors. They do import and export goods and services although they could have done these transactions within the region. The SLQ method also does not take the relative importance of the purchasing sectors into account.

In order to overcome these weaknesses Tiebout[4] suggested some modifications to SLQs. His method is called Purchase only or "Cross Industry Location Quotient" (CLQ) method. The CLQ's can be obtained as follows:

$$CLQ_{ij} = \frac{LQ_i}{LQ_j} = \frac{E_i^n}{E_j^n} \Big/ \frac{E_i^r}{E_j^i}$$

When the $CLQ_{ji} < 1$, then $A_{ij}^{TR} = A_{ij}^{n} \cdot CLQ_{ij}$ and

When $CLQ_{ij} > 1$, then $A_{ij}^{TR} = A_{ij}^{n}$ where

4. Tiebout, C.M. "Input-Output and the Firm: A Technique for Using National & Regional Tables", Review of Economics & Statistics, Vol. 49, 1967, pp.260-2.

A_{ij}^{TR} = regional domestic flow coefficients

A_{ji}^{n} = national technical coefficients

Shaffer & Chu[5] tested the results of this technique against the results of SLQ and actual data. They found that the modifications proposed by CLQ could not significantly improve the accuracy of the results of SLQs.

Hewings[6] examined the possibility of using non-survey techniques to simulate input-output tables for the West Midlands Region. His objective was to test whether the non-survey methods can be useful for simulating the regional input-output tables to at least an acceptable degree of accuracy in order to reduce the use of full scale surveys from the intra-regional input-output models. The method employed by Hewings involved SLQ, CLQ and relative supply and demand ratios as well as various iterative procedures. Regional control totals of gross outputs were developed from the census of production (1954). His model was also based on the three assumptions described at the beginning of this section.

Commenting on the procedure followed by Hewings, Round[7] pointed out further errors in the estimation of the final demand sectors. Round concluded that these errors invalidated the comparisons and

---

5. Schaffer, W.A., Chu, K. "Non Survey Techniques for Contructing Regional Inter-industry Models", PPRSA, 23 (1969), pp.83-101.

6. Hewings, G.L.D. "Regional Input-Output Models in the U.K., Some Problems and Prospects for the Use of Non-Survey Techniques," Regional Studies, Vol.5, 1971, pp.11.22.

7. Round, J. "Regional Input-Output Models in the U.K.; A Reappraisal of Some Techniques," Regional Studies, Vol.6, 1972, pp. 1-9.

projections made by the Hewings model. However, it may be suggested that Round's comments on Hewing's work cannot be fully justified. This is because his comments were based on the results of comparisons of two models, namely the Welsh model[8] and Hewings model and the objectives of the construction of the tables, and the sources of data collection are significantly different. Therefore, given the lack of data, Hewings' attempt to introduce mechanical means for the construction of regional input-output tables has merit. His work has aroused research interest in the application of non-survey methods in the construction of regional input-output tables in the U.K.

Morrison and Smith[9] used LQ techniques as advanced by Schaffer & Chu, for the provisional U.K. Input-Output Tables for 1966, to derive estimates for the intra-regional trade coefficients matrix for Peterborough. They compared these estimates with an independent survey-based input-output table for Peterborough. They accepted the disadvantages of using LQs for deriving trading coefficients and stated that "resonable estimates of trade coefficients could not be produced from a techical matrix which was widely inaccurate and there are many reasons why local technical coefficients may differ from their national counterparts."[10] However, given these weaknesses, tests of the Peterborough input-output tables have shown that non-survey based tables can provide a reasonable approximation to the actual input-output tables. This study has also concluded that the "simple location quotient technique is the most straightforward of the methods which have been mooted" and

8. Nevin, E.T., Roe, A.R., & Round, J.I. "The Structure of the Welsh Economy," University of Wales Press, 1966.

9. Morrison, W.I., Smith, P. "Non-Survey Input-Output Techniques at the Small Area Level; an evaluation," Journal of Regional Science, Vol.14, pp.1-14.

10. Ibid, p.1.

also "SLQ have been the more successful of the purely non-survey procedure."[11] In this way the results of the Peterborough study have prodvided some optimism for the use of non-survey techniques in simulating the regional input-output tables. Their findings also indicated the need for further research in order to improve the quality of the non-survey techniques.

Mandeville[12] put forward a non-survey technique which involves the use of "representative regional input-output coefficients." This method implies that some of the selected coefficients can be borrowed from the existing regional input-output tables when the non-survey based input-output tables are constructed. The reasons for borrowing coefficients from an existing survey table is that they are able to represent reasonable estimates of regional foreign trade, product mixes and the production functionsin selected cases. This model is based on the assumption that the regions have their own survey-based input-output tables. However, in the present context, this assumption is not practicable. On the other hand, when there is a regional input-output table already constructed and based on a survey, then the compilation of a non-survey based table with less independence than the existing survey table can hardly be justified. The argument is clear. If the aim of producing a non-survey input-output table is to test the feasibility of non-survey techniques in the construction of regional input-output tables, then the methodology used for deriving a non-survey based table should be independent of the survey-based table. The

11. Morrison, W.I., Smith, P. Input-Output Methods in Urban and Regional Planning: A Practical Guide, PRAG, Technical Papers T.P.6, 1976, p.88.

12. Mandeville, T.D. Linking APMAA to Representative Regional Input-Output Models; Aggregative Programming Model for Australian Agriculture, Research Report No.8, Dept. of Agriculture & Economics, University of New England, 1975.

survey-based table can then be used to test the accuracy of the derived methodology. Therefore, this method has some usefulness in projecting an existing table for some years ahead, but as a non-survey technique, this method has limited value in constructing regional input-output tables.

Mandeville's suggestion of using an existing survey table has further been extended by Harrigan et.al.[13] They examined the results of non-survey techniques using seven different tests. In contrast to Morrison and Smith, they concluded that the SLQ technique, in these tests, performed badly and failed to prove its significance. They found that the "Adjusted Cross Industry Location Quotient" (ACLQ) method could provide better results than the other non-survey techniques. Harrigan et.al then introduced more survey information to the ACLQ and tested the results against SLQ and RAS. However, these tests have indicated that the ACLQ method with more survey information was not able to simulate trade coefficients satisfactorily.

Further adjustments for the SLQ technique have been carried out in 1981 by the same authors.[14] They named their method "Generalised LQs" on which the proposed adjustments for SLQ were made. The aim of the adjustments was to introduce two main propositions to the SLQ methods. First the relative specialization in regional industry i, and second the relative requirements of i, for the other intermediate sectors in the region. They defined t^r_{ij} as a function of

13. Harrigan, F. J., McGilvray, J.W., and McNicoll, I.H. "Simulating the Structure of a Regional Economy," Environment and Planning A, 1980, Vol.12, pp.927-936.

14. Harrigan, F. J., McNicoll, I.H. Superior Information and Non-Survey Location Quotient Input-Output Simulation; Observation on Methods & Practice, Discussion Paper, University of Strathclyde, 1981.

regions relative specialization in industry i, which is denoted by S_i^r.

$$t_{ij}^r = f(S_i^r)$$

The above model has been further extended in order to introduce the relative requirements of industry i, as follows;

$$t_{ij}^r = f(S_i^r , R_i^r)$$

Then this model implies that the trading patterns of the region are determined by the interaction of relative demand and supply. The R_i^r , the relative regional coefficients should be measured as follows;

$$R_{ij}^r = A_{ij}^{nr} / A_{ij}^n \quad \text{where}$$

A_{ij}^{nr} denotes the regional technical coefficients and A_{ij}^n denotes the national technical coefficients. If R_{ij}^r is greater than the SLQ_i then $t_{ij}^r = SLQ_{ri}/R_{ij}^r$ and if the R_{ij}^r is less than the SLQ then $t_{ij} = 1$.

There are two main advantages of this model in regional analysis. Firstly it takes into account the possibility of regional trade coefficients being larger than equivalent national A_{ij}^n. Secondly, as Harrigan et.al. pointed out, these adjustments do not operate uniformly along commodity rows since each cell of the structural matrix is subject to modifications. Therefore, this model is free from the main weaknesse of LQ techniques, i.e. neglect of the effects of commodity cross-hauling. However, unlike other non-survey techniques, this model needs a pre-compiled regional technical coefficient matrix to obtain the R^r_{ij}. As pointed out earlier, in the discussion of Mandeville's method, it is very unlikely that an independently derived technical coefficients matrix for a region will exist. Therefore this model is also of some significance in measuring the regional specialization and differences in fabrication levels between the region and nation, when the actual regional technical coefficients matrix is available. Although the objective of putting forward this generalised version is to improve the quality of SLQ, it has limited practical value as a simulation technique in the absence of actual regional technical coefficients.

The second class of non-survey adjustments is called Supply-Demand Pool Techniques (SDP) or Commodity Balance Techniques. The main purpose of this method is to do adjustments to the national table in order to derive regional input-output tables. This idea was first originated by Isard, Peterson & Moore in the early 1950s. Schaffer & Chu[15] introduced some modifications to SDP method taking into account the disadvantages of SLQ technique, primarily the implications of regional demand when it is greater than the national demand and the importation of goods and services into the region even when the LQ of a sector is greater than one. This adjustment has been named the Regional Input-Output Table Simulator (RIOT) by Schaffer and Chu. It is assumed that the national technology applies for the regions. Local production is then distributed according to the pattern of national sales and the local needs. In each row, there is a pool of goods, in terms of

15. Schaffer, W.A., Chu, K. "Non Survey Techniques for Constructing Regional Interindustry Models," PPRSA, 23, (1969), P.92.

value for reallocation. Each column may also have a pool of needs. If the row with the pool is greater than its needs then the difference is considered to be exports. When the pool of the row is less than the regional needs, then the difference is considered to be imports. When there is a surplus of goods in the pool, the difference is added to the exports. When there is a surplus of needs, then the difference is reduced from the row i proportionately to A_{ij} and added to the relevant cells of the import row.

The assumption of the SDP method is that the regional trade is maximised. This means that the SDP technique also does not take account of the sectoral cross-haulage. The disadvantage of this procedure is that it gives rise to overestimates of the sectoral multipliers.

In commenting on the assumptions of SLQ Su[16] suggested, that the results would be closer to the actual tables if the estimated input-output table can absorb actual values for imports. In order to obtain the intra-regional trade coefficients for an area, he pointed out that it was necessary to undertake a survey of local firms to establish a set of import coefficients. The intra-regional trade coefficients can then be obtained by deducting the import coefficients from the estimated technical coefficients. Schaffer[17] has attempted to test this "import only" procedure. He produced a set of regional coefficients from the "export only"

16. Su, T.T. "A Note on Regional Input-Output Models", Southern Economics Journal, Vol.37, 1970, pp.325-327.

17. Schaffer, W.A. "Estimating Regional Input-Output Coefficients", Review of Regional Studies, Vol. 11-13, 1972, pp.57-71.

procedure and tested the results of the two methods against an actual survey-based table. He found his new method could produce more acceptable results closer to the survey-based table than the results of the "imports only" procedure. However, a series of Schaffer's tests on the non-survey techniques such as SLQ, CLQ, SDP, imports only, exports only and the survey-based techniques have shown that the survey-based procedures remain superior to the various non-survey estimating techniques.

Miernyk,[18] McDowall and Blake,[19] and McNicoll[20] constructed regional input-output tables following less formal methods; i.e. an iterative approach specifically in the balancing of the transaction tables. They all have introduced a considerable survey element into the tables together with published data and national input coefficients. Having constructed the input-output tables with direct surveys Miernyk, McDowall and Blake for example, used the iterative approach to balance the tables. For this purpose, McNicoll used "RAS" technique. However, his study does not show how to identify the role of "RAS" in constructing regional input-output tables, since he also estimated the structural matrix, final demand and primary inputs mostly with the observed data.

---

18. Miernyk, W.H. Impact of the Space Program on a Local Economy, West Virginia University Library, West Virginia, 1967.

19. Blake, C and McDowall, S. "A Local Input-Output Table" Scottish Journal of Political Economy, 14, 227-242

20. McNicoll, I.H. Some Aspects of the Impact of Oil on the Shetland Economy, Unpublished Ph.D Thesis, University of Stirling, 1977.

Jensen et.al[21] put forward a methodology known as the Generation of Regional Input-Output Tables (GRIT) system. This technique has been developed with the objective of using both national input-output tables and primary and secondary data resources available in the study region. The GRIT system is therefore clearly a combination of survey and non-survey methods. It allows modifications for mechanically produced tables "at the discretion of the analysts to produce more realistic input-output tables."22 It is clear, that the GRIT system is somewhat similar to the procedures, in particular the informal iterative approach in balancing the tables, followed by Miernyk, McDowall and Blake, and McNicoll.

One of the main arguments against this iterative approach in the construction of regional input-output tables is, as pointed out by Morrison & Smith, the time and effort required for satisfactory standard of modifications. Morrison and Smith also commented that "it was not possible to have a great deal of confidence in the modified matrices, rendering them to be merely pedagogical exercises and inhibiting their practical application."[23] This scepticism concerning the iterative procedures can hardly be justified. Given the fact that limited resources are available, if the values of cells are modified, after a significant amount of research work in the area, these estimates should be superior to those produced by techniques which rely upon less realistic assumptions.

---

21. Jensen, R.C., Mandeville, T.D. and Karunaratne, W.D. Regional Economic Planning: Generation of Regional Input-Output Analysis, Croom Helm Ltd., London, 1979.

22. ibid - p.9.

23. Morrison, W.I., Smith, P. Input-Output Methods in Urban and Regional Planning: A Practical Guide, PRAG, Technical Papers, TP6, 1976, P.86.

4.2 SURVEY-BASED SIMULATION TECHNIQUES

Since the late 1960s a survey element has been involved in the simulation of regional input-output tables, on different scales. The main objective of these studies has been to improve the accuracy of estimated input-output tables. One such technique is called "RAS" which is based on the notion that national input-output coefficients cannot be applied for the region. This is because there are prominent variations in the national and regional industrial structures. The applicability of RAS in regional planning has been discussed extensively in the U.K., although it has received less attention in the U.S.A. and other countries apart from the Netherlands.[24] One major characteristic of RAS should be distinguished clearly at the beginning of this discussion. RAS technique was originally proposed for projections of national input-output tables given the data for final demand sectors, intermediate sectors, and primary input rows for the projected year; but not as a simulation technique in constructing regional input-output tables.[25] Therefore, it is clear that these differences may cause obvious contradictions between the use of RAS in national and regional contexts.

The main hypothesis of the RAS method is that regional and national industrial structures are subject to variations due to differences in price, product mix, techniques, capital employed, productivity of labour and quantities of imports and exports. All these variations are categorised into two groups namely, substitution effects and fabrication effects. Firms may buy their inputs from

24. Tilanus, C.B. Input-Output Experiments, The Netherlands, 1948-1961, Rotterdam University Press, 1966.

25. For details see, Department of Applied Economics, University of Cambridge, Input-Output Relationships, 1954-1966: A Programme for Growth, No.3, 1963.

regional industries on different scales compared to their national counterparts. In effect the regional industries sell different proportions of their outputs to the intermediate sectors. This is called the substitution effect and is denoted by the letter R_i. On the other hand the technology used within the sector may vary between regions. This is called the fabrication effect, and is denoted by 'S_j'. The letter A denotes the estimated structural matrix.

This technique is based on several assumptions. First, it is assumed that price differences operate uniformly along the rows. When there are substitution effects and fabrication effects it is assumed that all these differences are applicable uniformly along the rows and down the columns. Having obtained the survey information on regional gross output, final demand sectors, primary inputs, and national technical coefficients matrix, an estimated regional technical coefficients matrix can be obtained as follows.

$A_1 = R_i\, A_o\, S_j$ where A_1 is the estimated technical coefficients matrix, A_o is the national technical matrix, while R_i is the diagonal matrix of substitution effects and S_j is the vector of fabrication effects. The methods for estimating A_1, S_j and R_i are discussed briefly in Appendix 4.1.[26]

The main advantage of the RAS method is that it takes into account the most obvious variations between regional and national industrial structures unlike non-survey techniques. Therefore some researchers, Morrison and Smith, for example, suggested that the RAS method can

26. For a detailed discussion see Bacharah M. Biproportional Matrices and Input-Output Change , Cambridge University Press, London, 1970.

be used for the simulation of regional input-output tables given the data for the marginal totals of rows and columns of intermediate inputs and intermediate outputs. They also found RAS to be the most superior method they have tested. Morrison and Smith also suggested that "in Britain data on sectoral intermediate inputs and outputs should be collected from an empirical survey; but this survey content is still considerably less than would be required."[27]

However, the main weakness of the RAS technique lies in its assumptions, which require adjustments of R and S multipliers uniformly down the columns and along the rows. This means that the change of intermediate inputs and outputs between the nation and the region has to be assigned to each cell evenly without taking any account of their contribution to technology and products mixes.

One of the main reasons for the change of technology and product mix, in the rubber and plastic products sector, for example, may be the replacement of natural rubber by synthetic rubber. As a consequence the purchases of this sector (rubber and plastic products sector) from the local chemical and oil products sector may increase while its purchases from other sectors remains constant. It is apparent that the difference in the totals of intermediate inputs between national and regional tables should be attributed to the cells belonging to the natural rubber and the chemical products sectors.

On the other hand, it is more likely that the changes in technology may occur in relation to the main inputs. When there are small

27. Morrison, W.I., Smith P. "Non Survey Input-Output Techniques at the Small Area Level: An Evaluation," Journal of Regional Science, Vol.14, No.1, 1974, p.13.

scale changes the final effects of such changes upon the production function may not be of great significance. This situation is also true in the case of substitution. Therefore, any method which is not able to distinguish the variations of substitution and fabrication effects by individual sectors is subject to errors of over estimation or under estimation of the values of individual cells.

Allen[28] tested the effectiveness of the simple RAS in projecting intermediate demands in the U.K. for 1968. Although his work has involved examining the use of RAS in the national context, his conclusion may be of some value for the regional studies. He used input-output coefficients for 1954 and marginal data on intermediate inputs and outputs for 1963. He derived two main conclusions. First, he found that the RAS model could produce a useful reduction in projection errors. His second conclusion was that substantially improved results could be obtained when relatively small amounts of additional information about major coefficients were introduced into the structural matrix.

Lecomber[29] reviewed evidence from other countries and concluded that the simple RAS technique was a failure. He found that the projections based on the RAS method involves unacceptable upward bias. Lecomber suggested that additional exogenous information

28. Allen, R.I.G. "Some Experiments with RAS Method of Updating Input-Output Coefficients", Oxford Bulletin of Economics and Statistics, Vol.36, No.5, 1974, pp.215-218.

29. Lecomber, J.R.C. A Critique of Methods of Updating, Adjusting and Projecting Matrices together with some New Proposals, Paper presented to Norwich Conference on Input-Output Analysis, 1971.

should be introduced into the updating procedure provided that the data were sufficiently available. He then estimated the coefficients of these cells separately. However, he found that the alternative adjustment procedure he derived for the simple RAS were not able to provide any improvements. The main reason was that his adjustments could not preserve the positive signs of the cells in the input-output tables.

Some research, the Shetland Study [30] for example, has used the 'RAS' method as a balancing technique. This means that data for the construction of regional input-output tables, including data for the structural matrix, are collected as far as possible from local surveys. When the data are not available for some sectors it is assumed that the input coefficients and the pattern of sales distribution in the national input-output tables are applicable to those of the region.

In balancing the tables McNicoll used RAS, which assigns the differences of U_i and U_j^*, and V_j and V_i^* evenly for every cell along the rows and columns. If the purpose of R and S multipliers is to take the substitution and fabrication effects into account, then the actual data collected from the survey and inserted into the structural matrix must undoubtedly have incurred these two effects. Therefore, when the RAS is used in balancing, the differences of $U_i - U_i^*$, and $V_j - V_j^*$ are again distributed evenly to all the cells without making any distinction between the cells which already have adjusted actual data and the cells which have been adjusted using the national coefficients. Hence, it is clear that the construction of regional input-output tables using local surveys and balancing

30. McNicoll, I.H. Some Aspects of the Impact of Oil on the Shetland Economy, Unpublished Ph.d Thesis, University of Stirling, 1977.

the tables with RAS techniques is subject to error, i.e., first overestimating some cells in the structural matrix and secondly and consequently, overestimating the multipliers. Therefore,the simple RAS method for simulating regional input-output tables is of limited use.

The discussion on non-survey and partial survey techniques has now offered a logical extension of recent work in the development of regional input-output models, together with a critical analysis of methods involved in the derivation of input-output tables. It is clear that the essential properties of the methods available to regional planners are first,the quality of the outcome and second, the convenience in constructing the input-output tables in terms of cost and time. In this light, the non-survey techniques are still acceptable because they save time and resources. Boster and Martin[31] for example, pointed out that the cost comparisons between a survey and non-survey model constructed for the state of Arizona have shown a budget difference with a ratio of 20 : 1.

This implies that when there are a number of planning strategies to be analysed and when planners use input-output tables for this analysis, the most likely choice for them, between the techniques discussed above, is the non-survey SLQ technique. By using it, regional planners can get an overall view of the economy with even less information for the cells of input coefficients. On the other hand the errors in using input coefficients derived from non-survey techniques may have less impact on sector multipliers. West and

31. Boster, R.S., Martin, W.E. "The Value of Primary Versus Secondary Data in Interindustry Analysis; A Study in the Economics of the Economic Models," Annals of Regional Science Vol.6, No.2, 1972, pp.35-43 .

Jensen[32] tested this hypothesis and came to the above conclusion. This hypothesis has also been examined by Walderhaug[33] and he stated that "the investigation suggests that technical coefficients for local input-output tables of acceptable quality can be developed from national input-output data, and that the costs would be less than those based on local surveys. The difference between the synthetic and survey based input-output flows for Washington State are with few exceptions well within an acceptable range."[34]

However, and as was pointed out by Round,[35] the applicability of simulation techniques is related to the relative regional size. This is mainly because of the different scales of inter-regional and foreign trade, and different scales of variations in technology, product mix, etc., between regional and national average. This clearly suggests that, a set of conclusions about the use of simulation techniques in regional input-output tables, derived from one case study may show considerable differences when compared to a set of conclusions derived from another case study.

In order to provide planners in Tayside Region with guidelines about the simulation methods that they can adopt with less cost,

---

32. West. G, and Jensen. R.C, "Some Effects of Errors in Coefficients on Input-Output Multiplers", Paper Presented to the Input-Output Workshop of the Second Meeting of the Australian and New Zealand Section of the Regional Science Association, Sydney, 1977.

33. Walderhaug, A.T., "State Input-Output Tables Derived from National Data", Proceedings of the Business Economics Statistical Section of the American Statistical Association, 1972.

34. Ibid. p.84.

35. Round, J.I, "An Interregional Input-Output Approach to the Evaluation of Non-Survey Methods." Journal of Regional Science, Vol. 18, pp. 179-194.

it is therefore essential to test the applicability of these methods in relation to a set of empirical data derived from the region. The input-output tables based on non-survey techniques, specifically using the SLQ technique, will be compared with a survey based table. In the present study, survey-based tables have been constructed by inserting more information into the structural matrix and by balancing the tables using less informal procedures. If the results of the tables based on SLQ are close enough to the results of survey based table the Tayside Regional planners can use the SLQ method in constructing and updating their input-output tables. Hence, in the following section the methodology used for deriving the SLQ based input-output tables for the Tayside Region will be discussed.

4.3 THE METHODOLOGY USED FOR THE SLQ BASED TAYSIDE INPUT-OUTPUT TABLES

4.3.1 MODEL

The objective of non-survey techniques is to derive a set of trade coefficients in relation to the national technical coefficients. The technical coefficients for Scotland can be defined as follows;

$$A_{ij}^{SR} = A_{ij}^{SD} + M_{ij}^{S} \qquad 1$$

where A_{ij}^{SR} = Scottish technical coefficients

A_{ij}^{SD} = Scottish domestic flow coefficients or trade coefficients

M_{ij}^{S} = Scottish import coefficients

It is assumed that the Scottish technical coefficients and the Tayside technical coefficients are equal such as,

$$A_{ij}^{TR} = A_{ij}^{SR} \quad \text{where} \quad A_{ij}^{TR} = \text{Tayside technical coefficients}$$

From equation 1, A_{ij}^{TR} can be defined as follows,

$$A_{ij}^{TR} = A_{ij}^{SD} + M_{ij}^{S} \qquad 2$$

A_{ij}^{SD}, within the Tayside model, can be further classified as follows;

$$A_{ij}^{SD} = A_{ij}^{TD} + A_{ij}^{ROUK} + A_{ij}^{ROS} \qquad 3$$

Where A_{ij}^{TD} = Tayside trade coefficients. A_{ij}^{ROUK} = puchase of goods from the rest of the U.K. to the Tayside Region, and A_{ij}^{ROS} = purchase of goods from rest of Scotland to Tayside. In the absence of data for estimating A_{ij}^{ROS}, and A_{ij}^{ROUK} separately, it is assumed A_{ij}^{ROS}, and A_{ij}^{ROUK} also as imports of the Tayside Region. These coefficients have then been included in the import coefficients, M_{ij}^{T}, of Tayside. Therefore from Eq.3, we can define technical coefficients of Tayside Region as follows;

$$A_{ij}^{TR} = A_{ij}^{TD} + M_{ij}^{T} \qquad 4$$

Then we can obtain A_{ij}^{TD}, Tayside trade coefficients as,
$A_{ij}^{TD} = A_{ij}^{TR} - M_{ij}^{T}$.

In terms of purchases of i from local industry j, this can be shown as,

$$A_{ij}^{TD} = t_{ij}^{T} \cdot A_{ij}^{TR} , \qquad 5$$

where t_{ij}^{T} denotes the Tayside Region trade share coefficients. It is assumed that, $1 \geqslant t_{ij}^{T} > 0$. If $t_{ij}^{T} = 1$, then $A_{ij}^{TD} = A_{ij}^{TR}$, which means that there are no imports required to produce j from the industry i. In other words industry i is able to provide the requirements of industry j. If $t_{ir}^{T} < 1$ that means industry i is unable to supply the goods for industry j and therefore industry j has to import.

In the Eq. 5, t_{ij}^{T}, and A_{ij}^{TR} are not determined independently. It is assumed that the locational factors will determine trading patterns and technical structures. Hence non-survey techniques may be viewed as ways of measuring the trading coefficients.

Data were not available to quantify A_{ij}^{TR}. Therefore, in the Tayside model, it is assumed that the scottish technical coefficients would be applicable for those of the Tayside Region. The final equation would then become;

$$A_{ij}^{TD} = t_{ij}^{T} \cdot A_{ij}^{SR} \qquad 6$$

4.3.2 AGGREGATION

Aggregation, as applied to input-output analysis, means reducing the size of the national table by collecting several homogeneous industries into classes, and combining the sectoral accounts within each class. In the present study, aggregation has been done for the Scottish Input-Output Tables for 1973, which consist of 78 intermediate sectors. The grouping has been carried out in two stages. In the first stage the work involved identifying the prominent sectors in the Tayside economy, and in the sector classification in relation to the minimum list headings of Standard Industrial Classification and Scottish Input-Output Tables for 1973.

It is seen that some sectors which appear in the Scottish Input-Output Tables could not be entered in the Tayside tables. According to the employment data provided by the Department of Employment these sectors, for example, coal mining, tobacco products, domestic electric appliances, wheeled tractor manufacturers, footwear, etc. do not exist in Tayside. If these sectors are included in the Tayside tables in the aggregation, it will cause an over-estimate in the technical coefficients. It is also the case that the resulting trade coefficients, and sectoral multiplers for the Tayside Region would be subject to over estimation. It is therefore apparent that the sectors which appear only in Scottish Input-Output tables should be avoided. This has been done by assuming that the requirements of inputs created by the non-existent sectors from the local industries as exports, and the amounts sold by these non-existent sectors to the Scottish local industries as imports. This means the values along the rows of the sector H,[36] have been allocated to the specific sectors as imports, while the values along the column of these sectors H, were allocated into the respective sectors as their exports. In this way the sectors H

36. Sectors appeared only in Scottish Tables, but not in Tayside.

could be omitted from the Tayside tables.

The second stage of aggregation was to combine the sectoral accounts for the classified sectors. For the purpose of the present study, two Scottish Input-Output Tables, namely "the total flow matrix, commodity x commodity", and "the domestic flow matrix, industry x industry" were aggregated. The first step was to aggregate the production accounts of the tables which has been done as follows,

$$X_{ij}^{G} = \sum_{i=1}^{n} X_{ij} + \sum_{j=1}^{m} X_{ij}$$

where X_{ij}^{G} denotes the value of the transactions of the grouped sector, and $i = 1....n$, and $j = 1.....m$, indicates the rows and columns incurred within the group.

The second step was to estimate the input coefficients for the grouped sectors, and this has been done as follows;

$$A_{ij}^{G} = \frac{X_{ij}^{G}}{X_j G_i}$$

where X_j^G is the value of total inputs of grouped sector j.

4.3.3 CONSTRUCTION OF TAYSIDE INPUT-OUTPUT TABLES BASED ON SLQ NON-SURVEY TECHNIQUES

Data for the estimation of LQs were obtained from the Department of Employment and the Scottish Abstract of Statistics. The method used to derive the SLQ was outlined in section 4.1.2. When the value of LQ is greater than one, it was assumed that the $t_{ij}^{T} = 1$, so that A_{ij}^{TD} has been obtained as follow,

$$A_{ij}^{TD} = A_{ij}^{SR}$$

When the LQ_i is less than one, $t_{ij}^{T} = LQ_i$,

so that,

$$A_{ij}^{TD} = LQ_i \cdot A_{ij}^{SR}$$

The Tayside Region input-output table, so derived, is given in Table 4.1.

Table 4.1. Tayside Region: Domestic Flow Coefficients Matrix

(Based on SLQ Non-Survey Technique)

PURCHASES FROM \ SALES TO	1	2	3	4	5	6	7	8	9	10	11
1. Agriculture	0.169	0	0	0.3747	0.1178	0.004	0	0	0	0	0
2. Fishing	0	0.0002	0	0.0281	0	0.0001	0	0	0	0	0
3. Mining & Quarrying	0.005	0	0.034	0.0	0	0.2239	0.0611	0.0001	0	0	0
4. Food Products	0.118	0.009	0	0.165	0.009	0.006	0.00009	0	0	0.00009	0
5. Brewing, Soft Drinks & Spirits	0	0	0	0.014	0.084	0	0	0	0	0	0
6. Oil Products & Chemicals	0.0406	0.0156	0.05	0.0084	0.0077	0.1695	0.022	0.006	0.01	0.0147	0.0063
7. Metal and Metal Goods Mfrs.	0.0004	0.0042	0.0037	0.0045	0.0096	0.0063	0.134	0.0827	0.0516	0.0594	0.0645
8. Mechanical Engineering	0.0095	0.0003	0.0041	0.0039	0.0102	0.0115	0.0103	0.1036	0.0086	0.0148	0.059
9. Instrument Engineering	0.00003	0.0001	0.0003	0.0001	0	0.0001	0.0001	0.0022	0.0642	0.0036	0.004
10. Electrical Engineering	0.00003	0.021	0.0014	0.0001	0.0005	0.0005	0.002	0.0289	0.1062	0.209	0.0355
11. Ship Building & Marine Eng.	0	0.0364	0	0	0	0	0	0.00005	0	0	0.0764
12. Textiles	0.002	0.0335	0.0	0.0006	0	0.0016	0.0017	0.002	0	0	0.0014
13. Clothing	0.0001	0.00017	0.0	0.0001	0.001	0.0008	0.0001	0.0002	0.0002	0.0002	0.00067
14. Building Materials	0.00005	0.0	0.00096	0.0008	0.0276	0.0011	0.0094	0.00326	0.0072	0.0088	0.0009
15. Timber Products	0.0003	0.0012	0.0014	0.0015	0.0294	0.0014	0.0038	0.0047	0.001	0.0035	0.0107
16. Paper, Printing & Publishing	0.0009	0.0009	0.0019	0.0224	0.0057	0.0115	0.009	0.0032	0.016	0.0112	0.0043
17. Rubber & Plastic Products	0.0012	0.0058	0.0022	0.0029	0.0028	0.006	0.0081	0.0157	0.0035	0.0077	0.0021
18. Construction	0.0294	0.00009	0.0137	0.0022	0.0036	0.0024	0.009	0.007	0.0031	0.0046	0.0029
19. Utilities	0.0102	0.0003	0.0213	0.0052	0.0098	0.0133	0.0256	0.0069	0.0055	0.0058	0.0092
20. Transport	0.0077	0.0281	0.1239	0.0129	0.0216	0.0143	0.0182	0.0097	0.0142	0.0129	0.0031
21. Communications	0.0046	0.0004	0.0016	0.001	0.0012	0.002	0.00257	0.00247	0.00257	0.00267	0.001
22. Distribution	0.084	0.05	0.0199	0.0343	0.0407	0.0073	0.0298	0.0148	0.0104	0.0128	0.0095
23. Finance Services	0.02696	0.054	0.0233	0.0074	0.01338	0.01038	0.00815	0.0086	0.0115	0.0104	0.01998
24. Professional & Business Services	0.0133	0.0007	0.0232	0.0158	0.0872	0.0319	0.0185	0.0248	0.035	0.033	0.039
25. Local Government	0	0.0004	0.00054	0.00015	0.0158	0.0064	0.0029	0.0037	0.0071	0.0044	0.0008
26. Households	0.1987	0.457	0.1637	0.1115	0.1485	0.1314	0.2699	0.3052	0.3527	0.2346	0.3664

Table 4.1. (Continued)

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0.1542	0	0	0.029	0.0083	0.0027	0.005	0	0	0	0	0	0.0002	0.0195	0.0188
0	0	0	0	0	0	0	0	0	0	0	0	0	0.0009	0.0029
0	0	0.0846	0	0.0026	0.0013	0.0195	0.0561	0	0	0.0001	0	0.00005	0.00007	0
0.0003	0	0.0002	0.00026	0.003	0.006	0	0	0	0	0	0	0.0009	0.0113	0.1198
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0254
0.034	0.0022	0.04	0.005	0.0346	0.148	0.008	0.048	0.016	0.004	0.009	0.003	0.0048	0.037	0.0116
0.0007	0.0043	0.0248	0.0143	0.0044	0.0067	0.0183	0.0043	0.0019	0.0016	0.001	0	0.0009	0.0018	0.0029
0.0112	0.003	0.0153	0.0054	0.0108	0.0074	0.0173	0.0121	0.02	0.0027	0.0051	0.0032	0.0031	0.0075	0.0071
0.0002	0.0001	0.0004	0.0001	0.0001	0.0003	0.0005	0.0034	0.0001	0.0001	0	0	0.0013	0.0176	0.0025
0	0	0.0029	0.0002	0	0.0002	0.0265	0.0214	0.0088	0.0787	0.0019	0.0007	0.001	0.002	0.0241
0	0	0	0	0	0	0	0	0.0028	0	0	0	0.0003	0	0.0001
0.2718	0.4403	0.0139	0.0325	0.0071	0.0725	0.0013	0.0	0.0036	0.0001	0.0043	0	0.0007	0.0022	0.0192
0.0002	0.00028	0.0004	0.00006	0.00028	0.0002	0.0002	0.00028	0.0009	0.0006	0.00028	0	0.0005	0.0019	0.023
0.0003	0.0001	0.023	0.0044	0.0005	0.0004	0.053	0.0002	0.0023	0.0002	0.0006	0	0.001	0.0012	0.001
0.0014	0.0001	0.0056	0.3871	0.0051	0.0026	0.0525	0.0002	0.0012	0.0003	0.0019	0	0.0027	0.0044	0.0076
0.0086	0.0065	0.0152	0.0027	0.298	0.0121	0.0011	0.0034	0.0027	0.0036	0.0153	0.0213	0.0404	0.018	0.0153
0.0104	0.0032	0.0098	0.0476	0.0054	0.08	0.0073	0.0015	0.0153	0.001	0.004	0.0002	0.001	0.0011	0.0027
0.0051	0.0047	0.0116	0.0041	0.0044	0.0034	0.2185	0.02	0.0059	0.008	0.009	0.0047	0.019	0.0254	0.005
0.0082	0.0036	0.0224	0.0057	0.0086	0.0132	0.0021	0.0575	0.0062	0.0017	0.0134	0.0056	0.0119	0.0154	0.036
0.0122	0.0094	0.0691	0.0154	0.0273	0.01	0.0047	0.0051	0.0588	0.016	0.03	0.0023	0.0039	0.0095	0.0267
0.003	0.00217	0.00316	0.0044	0.0074	0.00316	0.00158	0.00638	0.0084	0.0023	0.01247	0.0544	0.0083	0.0059	0.0099
0.0176	0.0131	0.0115	0.0158	0.0199	0.0107	0.0078	0.0117	0.0255	0.0187	0.0066	0.009	0.0032	0.0246	0.1973
0.01397	0.01358	0.01397	0.01416	0.0128	0.0132	0.0095	0.0097	0.0337	0.01445	0.024	0.0794	0.0255	0.0087	0.0121
0.033	0.0288	0.0234	0.0367	0.0298	0.0318	0.0042	0.0178	0.0145	0.0001	0.0389	0.0642	0.0743	0.006	0.1959
0.0037	0.003	0.0021	0.0038	0.0046	0.003	0.0007	0.0023	0.0085	0.0007	0.0012	0.069	0.0005	0.0007	0.0095
0.2407	0.2835	0.331	0.2256	0.3035	0.2851	0.2736	0.2416	0.5187	0.5377	0.3743	0.3854	0.301	0.692	0

CHAPTER 5

THE ECONOMIC SURVEY AND THE PREPARATION OF THE DATA BASE FOR THE INPUT-OUTPUT TABLES IN THE TAYSIDE REGION

INTRODUCTION

The objective of the economic survey carried out in the Tayside Region is specifically to collect primary data from unpublished financial records of regional establishments.[1] It has not been designed to collect primary data required for deriving all of the input coefficients of the Tayside domestic flow table due to limitations of research time and money. A part of the data base was gathered, therefore, from secondary sources. In this regard, one can view the final tables so completed as partial-survey input-output tables. The aim of this chapter is to discuss the procedures involved in organising and conducting the survey and the preparation of the data base.

5.1 THE ECONOMIC SURVEY

5.1.1 SELECTION OF THE SURVEY AREA AND BASE YEAR

The region for the present study was pre-specified by the conditions of the research grant. There is one notable characteristic by

1. Establishments in the present context are defined as any private or public unit which engages in the provision of goods or services.

which this study area can be distinguished from some other regional input-output studies in the U.K. As shown in Table 5.1, the Tayside Region covers a larger area in terms of size and population compared with the areas covered by the studies of Shetland, St.Andrews, Sutherland and Peterborough. The area of the West Midlands Regional Input-Output Study has not been included in this table because Hewings[2] did not introduce a considerable survey element into his study.

The determination of the boundaries of the survey area has effects upon the accuracy of the analysis. The boundaries of the Tayside region, especially in the south of the region, do not coincide administratively and economically. When the Tayside area is determined in economic terms one of the main factors that ought to be considered is employment in terms of job places where people work. Many people work in the city of Dundee, but live in the northern Fife Region.[3] This implies that the housing market for Dundee extends to northern Fife. This situation can also be witnessed in the west boundaries of the Tayside Region although its significance is not so prominent. On the other hand the Telephone Exchange Area and the circulation area of the Dundee newspapers include the north of Fife as a part of the Tayside Region. The complex nature of these boundaries has created difficulties for the local authorities in framing policy instruments, for example, in relation to decisions regarding housing development in the Region.

2. Hewings, G.J.D. "Regional Input-Output Models using National Data: The Structure of the West Midlands Economy," Annals of Regional Science. 3 (1969),pp.179-91

3. Data are not available to quantify the number of working population in Dundee living in the North of Fife.

TABLE 5.1

Regional Areas Covered by the Input-Output Studies in the U.K. (Classified by Size of the Area and Population)

Regions	Size of the Area (Hectares)	Population in 1979
Tayside	750,318	401,700
Shetland	143,268	21,450
Peterborough	n.a.	80,000 *
St.Andrews	n.a.	10,120 *
Sutherland	n.a.	13,148 *

Source:- Rating Review, 34th year of issue, June, 1979, Scottish Abstract of Statistics, 1982.

* The data on the population of Peterborough, St.Andrews and Sutherland refer respectively to the years 1968, 1965 and 1970.

The boundaries of the Tayside Region have been subject to formal change during recent years. Before 1975 the North of Fife, for example, was included in the administrative area of Tayside Region. The major impact of changing boundaries in this way is that it gives rise to an inconsistent set of statistics which affects regional research. Because of this, it was not appropriate to delineate the survey area merely on the basis of economic or administrative boundaries. However, for the convenience of data collection, the area for the present survey has been defined as the Tayside Region administrative area as approved by the Boundary Commission for Scotland in 1981. This definition was consistent with the objectives of the study.

The main factor influencing the selection of the base year was the availability of secondary data. The latest census of employment in the Tayside Region was for the year 1978. The registers of manufacturing, oil related industries and engineering were available in the Planning Department of Tayside Regional Council for the year 1980. When the present study was started, the Scottish Input-Output Tables for 1973 were being updated for 1979, so that it was believed that there might be easy access to company information for Tayside Region through the Scottish Planning Department.

The selected base year ought not to be too historical because it causes companies some difficulties in accessing their files. If the selected base year is the latest calendar year, the respondents normally have ready access to their recent financial reports required for the study. On the other hand the base year ought not to be too recent because some competitive companies may not wish to disclose their recent financial position in any detail.

The selection of the base year is also affected by the length of the period needed to process the data and to complete the analysis. Normally this consumes a long time and the economic analysis based on the data may be out dated to be incorporated into the regional planning machinery. Therefore, on the one hand, up-to-date statistics are likely to be more relevant to regional policy making and firms may have ready access to their financial data. On the other hand, it is desirable to relate these surveys directly to regional firms and also to national data and firms may be more willing to provide data which does not disclose their current competitive positions. After taking all these factors into account the year 1979 was selected as the base year for the present study.

5.1.2 SECTOR CLASSIFICATION AND AGGREGATION

There is no uniform sector classification system for regional input-output studies. The sector classification varies from region to region and depends primarily on the characteristics of the regional economies. The Shetland Input-Output Study,[4] for example, has 16 intermediate sectors while the Peterborough Input-Output Study[5] was undertaken for 25 sectors. Such differences in sector classification can partly be explained in terms of the relative specialization of activities in the regions. Other main factors, influencing the different degree of sector classification, are the varying levels of technical linkage between the sectors, the purpose of the study, the availability of data and the other

4. McNicoll I.H., The Shetland Economy, Research Monograph No.2, The Fraser of Allander Institute, 1976.
5. Morrison W.I. and Smith P., Input-Output Methods in Urban and Regional Planning: A Practical Guide, PRAG Technical Papers, TP6, 1976.

resources required for collecting, processing and analysing the data.

The major difficulty arising in the sector classification was the definition of the sector. The sector can be defined as a category of one or more establishments having common input, technology, and output. In practice, however, there are many problems in preserving this concept of homogeneity in the input-output study. For example, manufacturing establishments especially in declining sectors in the Tayside economy have started to introduce new strategies into their company planning. These strategies have partly been directed to diversifying their production structures from single product line to multi-product lines (See Chapter 3). Some firms have introduced new marketing concepts and new technology into their production. Consequently these strategies have given rise to variations in sector classifications and variations in intra-sectoral production functions.

One way of dealing with this situation is to aggregate all the products and services of multi-product firms together and to treat them under the umbrella of the main product. Sidlaw Industries Ltd., for example, was undertaking three main activities, namely textiles, servicing of North Sea oil and gas exploration, and trade distribution of hardware products in 1979. The main activity was the textile production which consisted of 68% of the total turnover in 1979. This establishment could therefore be classified in the textile sector. The disadvantage of this procedure is that any sector may not reflect accurately its true production function.

Alternatively, the output of each product of multi-products manufacturing establishments could be separated together with the associated inputs from other products and assigned to its own sector. In this way all the sectors would include only homogeneous products or services, reflecting their true production function. Also, sectoring by this method could produce more accurate results for the forecasting and impact analysis. However, the data reorganisation involved would have required a research team backed by sufficient resources, and this is beyond the resources of any individual academic researcher.

The first step of the procedure in sector classification followed in the present study was the preparation of a master list which included all large and small manufacturing firms, and financial and trade services. Professional services, agricultural establishments, retail and grocery shops, households, other miscellaneous services, and public sector institutions were excluded from the master list. Theoretically any one of these sectors should not be excluded from the sample survey if accurate input coefficients were to be derived. However, in practice, this omission had to be justified on three grounds. Firstly, a considerable amount of secondary data was available for the public sector organisation and for the agricultural sector, compared with the other sectors of the Tayside economy. Secondly, the size of the population of other sectors excluded from the survey, such as households, retail and grocery shops, miscellaneous services and professional services, consisting of small scale establishments, was too extensive to include in the master list. Thirdly, it was assumed that the regional variations of the input coefficients of these sectors of Tayside, within the context of Scotland, were not significant compared to the manufacturing sectors, so that the same Scottish input coefficients could be applied for the Tayside Region.

The starting point in listing the establishments was the Official Yellow Pages of the Telephone Directory of the Tayside Region for 1980. The use of Yellow Pages coverage for this purpose has some disadvantages. The main one is that the trade classification system in this Directory does not follow the Standard Industrial Classification (1968). Secondly, there are some large establishments which do not use Yellow Pages but use the main Telephone Directory. Thirdly, the boundaries of the Yellow Pages coverage for the Tayside Region do not coincide with the boundaries of the study area, so that an attempt had to be made to identify those establishments located outside the region.

There were some reliable sources which could be used in order to improve the Yellow Pages coverage. The lists of employers in Tayside for 1976 and 1977,[6] the KOMPASS in 1980,[7] the Directory of Key British Enterprises,[8] Registers of Manufacturing, Engineering, and Oil related industries,[9] the Buyers' Guide and Trade Directory[10] and local newspapers in 1979 and 1980 were used to

---

6. These lists were provided by the Manpower Services Commission in Dundee.

7. KOMPASS, United Kingdom, 1980 (18th Edition), KOMPASS Publishers, 1980.

8. Key British Enterprises, The Top 20,000 British Companies, 1980 Dun & Bradstreet, London, 1980.

9. These registers were compiled in 1980 by the Department of Planning in Tayside Regional Council.

10. Buyers' Guide and Trade Directory, 1980, Dundee and Tayside Chamber of Commerce and Industry, Dundee, 1980.

obtain a comprehensive master list. From these sources, any possible omission of a geographical area or complete or partial omission of some sectors could be identified. These sources were invaluable in identifying large firms in terms of employment, activities of firms, and also in distinguishing manufacturers, service establishments and trade services from the Yellow Pages coverage.

However,there were some weaknesses in these supplementary sources. Some such as KOMPASS and KBE, covered two main areas, i.e. Dundee and Perth,more comprehensively than others. The Directory of Tayside and Perth Chamber of Commerce, for example, covered only the members of the Chamber. The most common weakness of all these sources was the lack of coverage provided for small scale establishments. A more complete coverage of all commercial and industrial establishments in Tayside could have been obtained from the Gas Board and Hydro Board of Scotland, but the disadvantage of using these lists was the difficulty of assigning names and addresses to the relevant industries. The final master list was therefore compiled adjusting the list of Yellow Pages according to the information provided by other sources. A separate card system was prepared in order to list the main features of every establishment in the sample frame. Each unit of the sample frame, which consisted of nearly 1900 establishments, was given a separate card. This system was helpful in classifying and aggregating the sectors and for selecting the samples by sectors.

Initially the master list was classified into 312 activities. The definition of activities used in this stage was primarily homogeneity of goods produced or identical services. The main problem arising at this stage was in allocating these activities into an appropriate number of sectors. For accurate analysis, the next step was to assign these activities into the sectors in such a way that firstly no product should appear as the output of more than one sector, and secondly, the products within a product group should be homogeneous in the sense that they require the same kinds and same quantities of inputs to produce the same kind of output. This means the output of each sector is a commodity which can be produced by one production function. This property of the sectors cannot be preserved realistically in the classification systems because of statistical limitations. Therefore, some flexibility had to be introduced into the sector classification and aggregation, so as to relieve its rigidity.

A close approximation for this definition would be the possibility of aggregating sectors based on either the similarity of input structure or the similarity of outputs of several activities. The activities which can be used as substitutes, for example, soft drinks and spirits, can also be aggregated into one sector. However it should be noted that each of these alternative procedures has its advantages and disadvantages. Therefore, the problem was approached by applying these procedures for the cases according their relevance, because of the heterogeneous nature of the characteristics of the activities. For example, the researcher may be convinced that there are some activities which are close substitutes. These activities can be aggregated into one sector. Also there may be some activities which need inputs of the same category, for example, metal and metal goods used for different kinds of manufacturing activities; and these manufacturing activities can also be aggregated.

On the other hand, in some economies there are large numbers of different manufacturing activities which are highly interrelated in terms of buying raw materials and selling final products to and from each other. For this type of economy a more disaggregated input-output table could produce more acceptable results. There are other economies in which a small number of activities exist, and they have no significant inter-industrial relationships with each other. In this situation a more aggregated input-output table may produce the anticipated results. In the Peterborough Input-Output Study, for example, 57 manufacturing sectors in the U.K. Input-Output Table in 1968, have been aggregated into 12 sectors. Also the trade and miscellaneous services sector of the U.K. table was disaggregated into four sectors for the Peterborough input-output tables.[11] Therefore the degree of aggregation of activities into sectors is dependent on the researcher's understanding of the economic structure of the study area, the purpose of the study and the availability of resources for the project.

Some preliminary work in investigating the special characteristics of the Tayside economy was carried out before the final aggregation. This work benefitted from discussions with the officials of the Planning Department of the Tayside Regional Council and other personal interviews, local newspapers and the literature of the Tayside and Perth Chamber of Commerce. The employment data classified by MLH of SIC[12] and by areas of Tayside

11. Morrison W.I., and Smith P. Input-Output Methods in Urban and Regional Planning: A Practical Guide, PRAG Technical Papers, TPG, 1976, p.70.

12. The revised Standard Industrial Classification (1968) has 181 minimum list headings grouped into 27 orders. Full details are available in Standard Industrial Classification-Alphabetical List of Industries (Revised 1968), 1974 (Second Impression), HMSO.

Region obtained from employment returns of Department of Employment were of vital importance in identifying prominent sectors of the economy.

The starting point of the process of aggregating activities was the Standard Industrial Classification. Each establishment was given an MLH number of SIC based on its activities. A judgement had to be made in respect of establishments with multi-product lines, where products appeared under different MLH of the SIC. The final classification and aggregation were done in two stages. In the first, 312 activities were classified into 78 sectors in line with the Scottish Input-Output tables and the SIC. In the second, these 78 sectors were aggregated into 26 intermediate sectors, distinguishing major characteristics of the Tayside economy. In some cases there were only a few small scale establishments under the proposed sectors. These sectors had to be absorbed by the other related sectors in the final sector classification to prevent any disclosure of confidential data. Some sectors such as tobacco and footwear, were also omitted because of the lack of importance of their activities in the Tayside economy in terms of employment. Table 5.2 lists the sectoral classification of the Tayside Input-Output tables in relation to the sector classifications of the Scottish Input-Output tables as well as in relation to the SIC.

The main weakness of this classification is however, that it is not able to reflect the real structure of the economy by way of final products, raw materials or process. The textile sector for example, includes the establishments which produce hessian as inputs for the textile industry, establishments which are involved

Table 5.2. Classification of Sectors for the Tayside Survey-Based Input-Output Tables.

TAYSIDE TABLE NOS	SECTOR NAME	SCOTTISH TABLE SECTOR NOS	SIC 1968 MLH
1	Agriculture	1,2	001, 002
2	Fishing	3	003
3	Quarrying and Oil Exploration	6,7	102,103,109,104
4	Food Products and Processing	8,9,11,12	212,213,214,216,217,211,215, 218,219,221,229
5	Brewing, Soft Drinks and Spirits	13,14	231,232,239
6	Oil Products and Chemicals	15,16,17	261-263,271,272,273,275-279
7	Metal and Metal Goods Manufacture	18,19,37,38	311-313,321-323,395,390-393, 396,399
8	Mechanical Engineering	20-26,34,35 59	331,332-334,336.337,338,341, 335,339,342,349,384,385, 380-382,383
9	Instrument Engineering	27	351-354
10	Electrical Engineering	28-31,32,36	361,362-367,368,369,394
11	Shipbuilding and other Marine Eng.	33	370
12	Textiles	39-42,43,44	411-419,421-423,429
13	Clothing	45-47	441-443,446,449
14	Building Materials	48,49	462,464,469
15	Timber Products	51,52	471-475,479
16	Paper, Printing & Publishing	53-56	481-486,489
17	Rubber and Plastic Products	50,57,58	491,492,496
18	Construction	60	500
19	Utilities	61-63	601-603
20	Transport	64-67	701-705
21	Communication	68	706-708
22	Distribution	69	810,812,820,821,831,832,894
23	Finance Services	70	860-862
24	Professional and other Business Services	71,74,75,76	709,863-866,871,873,876,879, 884-888,875,881-883,889,891-893, 895
25	Local Government	72,73	872,874
26	Households		

in producing textiles, i.e. spinning and weaving, and also establishments which produce final products such as carpets. If greater resources had been available for the research, this sector could have been classified at least into two sectors, by way of raw materials and final products, for an accurate analysis of inter-industry dependence.

5.1.3 SELECTION OF SAMPLES

Many survey designs are possible depending on the size of the region, the nature and characteristics of its sectors, the objectives of the study and the available resources. In the Tayside Input-Output Study the limited resources relative to the size of the region and the objectives made it necessary to have an appropriate sampling system of establishments in the Tayside Region.

There was no uniform sampling technique adopted in the selection of the sample due to the impracticality of applying them for the whole test population. The heterogeneous nature of the characteristics of the units of the population suggested that the population parameters could not be obtained accurately without a complete census and a high level of response. Therefore,the validity of the results of the sample cannot be tested mathematically. Some sampling techniques such as random sampling have therefore to be applied on a sectoral basis.

Some difficult problems arose in sampling especially with manufacturing establishments. There were important variations among the establishments within the sector in terms of their product mix, size of capital investment, type of inputs used and type of output. Theoretically these establishments could be stratified within a sector by their characteristics and then samples could be drawn on a random basis. However, it was clear that there were only a few establishments within each stratum so that any type of sampling method could not be applied meaningfully.

Some workable definition of adequate coverage for any sector therefore had to be found. The definition used in this process was that there should be a sufficient number of firms in each sector to be sampled for the derivation of coefficients which could reflect the sectoral production functions. Hence, more than two establishments have to exist in each sector.

Table 5.3 shows the number of establishments in the population by sectors and the size of the samples. There were two phases of sampling. The first phase of sampling consisted of 300 establishments while the second consisted of 150 establishments.

Large establishments were pre-selected for the first sample. It was assumed that they could provide more detailed and reliable information than smaller establishments. The large establishments also accounted for a higher proportion of the total inter-industry flows from which the values of the coefficients could be derived. Some problems arose in drawing samples for sectors which had relatively small numbers of firms. The inter-industry transactions of these sectors, such as brewing, soft drinks and spirits, were expected to be important. Relatively large samples were drawn from these sectors. Also, for the main sectors of the economy such

Table 5.3. Population, sample, size, and Results of the Postal Economic Survey of the Tayside Region.

DESCRIPTION 1	POPULATION 2	SIZE OF THE SAMPLE AS A % OF POPULATION 3	% OF POSSITIVE RESPONSE 4	EMPLOYMENT COVERED 5	AS A % OF TOTAL EMPLOYMENT 6
1. Fishing	14	28	-	-	-
2. Mining and Quarrying	24	5	100	1095	46
3. Food Products	127	36	6.5	256	6.5
4. Brewing, Soft Drinks & Spirits	34	53	22	119	6
5. Oil Products	51	49	8	99.5	4.2
6. Metal and Metal Goods	92	16	33	239	10
7. Mechanical Engineering	232	29	13.4	1023	20
8. Instrument Engineering	26	27	43	100.5	1.4
9. Electrical Engineering	75	45	9	1736.5	70
10. Ship Building	21	24	20	3	0.18
11. Textiles	78	73	19	3163.5	33.2
12. Clothing	21	57	25	59.5	4.3
13. Building Materials	94	18	12	385	55.5
14. Timber Products	43	74	6	145	8.4
15. Paper, Printing and Publishing	69	32	9	233	5.3
16. Rubber and Plastics	18	100	5	404	28.9
17. Construction	88	15	23	1199.5	10.1
18. Communication	2	100	50	2330	86
19. Transport	159	6	50	214.5	4
20. Distribution	83	46	37	1052	4.4

as textiles, large samples were drawn. There were some sectors which consisted of a large number of small scale establishments with fairly homogeneous characteristics, such as banking, insurance and road transport. Small samples were drawn from these sectors.

In the second phase of sampling much more flexible methods had to be followed. The aim of this phase of sampling was to obtain data for the sectors for which the response from the first sample was poor. Therefore, the methods of sampling in the second stage were influenced largely by personal judgement and experience gained from the first phase of sampling.

5.1.4 SURVEY METHODS AND QUESTIONNAIRE DESIGN

The survey method used was primarily the mailed questionnaires. It was hoped to supplement these postal survey by a small number of personal interviews. The aim of the personal interviews was to increase the response rate in the sectors which were of vital importance for the construction of input-output tables and to obtain some more detailed and accurate information.

As the postal survey was the principal means of obtaining the necessary data base, much consideration was given to the designing of the questionnaire and the letters. The initially designed questionnaire was a lengthy one covering the most needed areas of the construction of the input-output tables. Some questions, for example, were included regarding the transport costs involved with each item of input purchased and output sold. These questions were included for the purpose of valuation of transactions. However, this questionnaire was tested in a pilot survey which included 35 establishments. In this survey nearly all the major sectors were attempted. Although the positive response rate received was encouraging (it amounted to nearly 20%) it suggested also the necessity of a simplified questionnaire in order to increase the response rate. In modifying the questionnaire at this stage, many questions designed for collecting data for the various aspects of the analysis, such as transport margins for valuation of transactions, and inter-industrial linkages had to be eliminated. However, this could be justified by the increase in the response rate. The simplified questionnaire designed for the manufacturing sector establishments is shown in Appendix 5.1.

A need for further simplification was indicated by the results of the first phase of the survey. The size of the questionnaire for the second phase of the survey was limited to two pages. The aim of this questionnaire was only to cover the main financial data which could easily be made available by establishments. The analysis of financial data in terms of destination of sales and origins of purchases was largely dispensed with.

The main problem encountered in designing the questionnaire was the applicability of questions to all of the sectors in the economy. It was clear that some questions which were relevant to the manufacturing sectors did not have the same relevance for the sectors which did not play a significant role in terms of providing inter-industry relationships. In order to combat this problem, separate questionnaires were designed for the manufacturing, service, and trade sectors.

5.1.5 CONDUCTING THE SURVEY

The economic survey for the Tayside Region was conducted in two stages namely the mailing of questionnaires (postal survey) and a limited number of personal interviews. This was undertaken in the first part of 1982.

The postal survey was undertaken in two stages. In the first phase 300 establishments were contacted. An initial letter was sent to each member of the sample explaining briefly the nature, purpose and objectives of the study. These letters were followed within a short time by the questionnaires together with covering letters. The covering letter described in detail the objectives of the study and its relevance for the local planners and business community in the Tayside Region. It also emphasized the confidentiality of data and gave a brief description of the research panel.

Only one follow-up letter was tried and this was sent together with copies of the questionnaires within the first four weeks of the start of the survey. This procedure helped to increase the positive response.[13] In the first phase of the survey the follow-up letter caused the positive response to increase by 4%. The same procedure was followed in conducting the survey for the second sample.

---

13. "Positive response" is defined in this study as the response received from establishments by completing the questionnaire. Negative response is referred to the response received from establishments which did not complete the questionnaire but indicated the reasons.

Personal interviews were conducted in August, 1982. A sample of establishments was selected from the master list for this purpose. There were only twelve interviews planned initially. In drawing the sample, attention was focussed on the sectors which had least respondents from the postal survey. A letter was sent to each number of the sample and they were followed by telephone calls. The interviews were arranged accordingly with those willing to co-operate.

5.1.6 EFFICIENCY OF THE SURVEY

There were three kinds of response which could be identified in this postal survey. First, there were establishments who gave a positive response in completing almost every section of the questionnaire. Second, there were establishments who did not complete the questionnaire but indicated their reasons for not participating in the survey. The third group consisted of those establishments who did not participate in the survey in any way, i.e. non-respondents. The examination of the second group of establishments who gave a negative response helped in the identification of some factors which might be useful for further research.

Table 5.4 lists these firms, classified by their various reasons for not completing the questionnaire. The main reason given by 26% of these establishments was their inability to afford the time and effort to respond positively due to pressure of work. There were two reasons for the pressure of work especially in two periods of the year, i.e. when the accounts departments of estab-

Table 5.4. Reasons for not Participating in the Survey Revealed By The Negative Respondents.

REASONS	NO. OF FIRMS	PERCENTAGE
1. Cannot afford the time and effort required due to pressure of work at the particular time of the year.	21	26
2. Due to all marketing, advertising and accounting being controlled from Head Office, located outside the region.	8	10
3. No longer operate in the region.	4	5
4. Corporate policy prevents from releasing confidential information.	11	14
5. Integrated with other firms.	3	4
6. Do not wish to participate on voluntary basis.	2	2.5
7. Being the Head Office of the large number of branches scattered throughout the U.K.	1	1
8. Do not wish to participate.	21	26
9. Unable to complete.	9	11.5

lishments compile their annual reports and year end financial accounts, and holiday times. Both phases of the present postal survey had to be conducted during these critical periods i.e., March and July. On the other hand nearly 11% of establishments indicated their inability to complete the questionnaire mainly because of the complexity of the questions. This means that the positive response could have been increased further, given a simplified questionnaire.

The average positive response received for the present postal survey was 17.9%, resulting in 77 workable questionnaires for the data base. This rate of response can be considered acceptable when compared with the results of the other postal surveys used for input-output studies. For example, the Peterborough postal survey[14] conducted for trade sectors with only 2 pages of questionnaire had received a 19% response while the Scottish postal survey[15] received only a 2% positive response. The enthusiasm of some respondents for the Tayside Input-Output study was overwelming. Some returned completed questionnaires with copies of their confidential cost reports. Some returned the questionnaires with confidential financial reports provided for government departments. In general, the information was given to the nearest £, and remarkable efforts were made by some respondents to complete every section of the questionnaire accurately.

---

14. Morrison, W.I. "The estimation of Control totals and the calculation of direct coefficients for the distributive sectors in a local input-output study",in seminar on the <u>Construction and use of Small Area Input-Output Tables</u>, Conference Paper 1, Centre for Environmental Studies, London, 1970.

15. McGillvray, J.W. <u>Construction of the 1973 Input-Output Tables for Scotland: A summary of experience</u>, Discussion Paper 20, The Fraser of Allander Institute, University of Strathclyde, Glasgow, 1981.

However, the results of personal interviews were much less encouraging. Only four personal interviews, including one at British Telecom (Dundee), were conducted. However, in terms of employment the personal interviews covered 1.5% of total employees in the Tayside Region.

The analysis of positive response by sectors[16] reveals that 11 sectors of the economy, namely brewing and soft drinks, metal and metal goods manufacturers, instrument engineering, ship building, textiles, clothing, construction, communication, distribution and finance had responded at well above the average rate. On the other hand the employment coverage by these sectors accounts for 5.89%[17] of total employees in the region. This indicates that the sectoral representation of the workable questionnaires is of greater significance than the average rate of positive response would indicate.

Apart from the reasons indicated by the negative respondents, one of the main reasons for non-response was the nature of the questionnaire. The length of the questionnaire itself was not entirely responsible for this situation. However it was clear that there were some questions which needed a considerable amount of staff time to obtain information from various departments. The completion of the whole questionnaire was not an individual effort but often a team one involving several departments. This was particularly significant in relation to larger establishments.

---

16. See Table 5.3.

17. The coverage factor of the whole Survey obtained by the positive response in terms of employment was 8.58 percent. The number of establishments responding positively also represented 4.16 percent of total number of establishments in the test population.

Some firms revealed that the most difficult part of the questionnaire was to find the necessary information regarding the origin of their raw materials and the destinations of the final products. Some revealed that they were unaware of the destinations and origins since these transactions were made through various distribution channels. Some establishments indicated that they would prefer not to respond to the survey at all rather than send partly completed questionnaires.

Bulmer Thomas[18] has suggested that the effort made to obtain the information regarding the distribution of sales from the manufacturing industries should be eliminated. The alternative source that he proposed in collecting this information was the distributors. However, a number of telephone contacts with the distributors in the Tayside Region revealed that they were also unable to provide the relevant information because an inordinate amount of staff time was needed to gather the data from their original accounts books, and collate them. It was unlikely that the trade sectors could devote their time voluntarily to this unless this information was required by the government departments. In contrast to Bulmer Thomas's suggestion, the survey suggested that the information about distribution of sales and origin of raw materials could be obtained from large manufacturing establishments. The explanation for this was that the analysis of sales distributions especially, played a major role in company planning. This was also one of the major advantages of contacting the large establishments for the survey.

---

18. Bulmer Thomas, V. "The Valuations of Transactions in Input-Output Tables," Journal of Economic Studies, Vol.5, 1978, p.8.

5.2 PREPARATION OF THE DATA BASE FOR THE CONSTRUCTION OF INPUT-OUTPUT TABLES

The preparation of the data base was carried out in three steps, namely processing the data of individual questionnaires, preparation of working sheets and grossing up the data of the working sheets for the control totals and the relevant coefficients of the final table. All the data of the usable questionnaires were manually processed. It was seen that the computer data processing was not always satisfactory particularly in the initial stage of the survey. The main reason for this was that the computer could not be substituted for good judgement and careful analysis of data where these were most needed. Therefore, computer data processing might cause distortion in the real values of sectors in the region. The data given in each section of the questionnaire were scrutinised and comparisons were made with that of other establishments in the same sector. In this way major inconsistencies in the data could be identified.

A problem arose in treating the various kinds of inconsistencies in the data base. The most crucial factor in this process was to identify the reasons for the variations before making any judgement as to how to treat them. There were three major factors which were most prominent. Firstly, the data reflected differences in economies and diseconomies of scale within the establishments, for example, variations in the productivity of labour among the establishments which were producing homogeneous outputs. Secondly, the data reflected differences in the degree of specialisation and also differences in technology. Thirdly, the data provided by some respondents were not consistent compared with the cost structure of the same establishment, due to misinterpretation of the questions. No attempt was made to deal with the first and second factors. However, adjustments were needed for the third factor.

The best way to treat this factor was to contact the relevant respondents using the telephone or to visit them in order to obtain correct information. However this aspect could not be pursued in all cases, for reasons of confidentiality, unless the respondents had expressed their willingness for further contacts. The telephone inquiries were made for identifiable firms and the variations of data could be clarified accordingly. A difficulty arose in treating the inconsistent data given by unidentifiable respondents. In order to overcome this difficulty a formula was derived for estimating average ratios of the individual cost items such as the cost of raw materials, operating cost, transport cost, etc., to the gross sales of establishments, as follows;

$$R_{C_j} = \frac{\sum_{i=1}^{n} \frac{(C_j \times 100)}{g_i}}{n}$$

where R = ratio of the cost of idividual items to the gross sales.

C_j = the cost of "j"th item of the establishment. ($j = 1,2 \ldots\ldots\ldots m$)

g_i = value of the gross sales of "i"th establishment. ($i = 1,2 \ldots\ldots\ldots n$)

n = the number of positive respondents in the sector

These ratios were used for treating the uncompleted sections of the questionnaires, ironing out inconsistencies in the data, upgrading the data of poor returns and also for making comparisons with the secondary data.

The next step in data processing was the preparation of working sheets for each sector of the input-output tables. The main property that the working sheets had to preserve was that they had to reflect the sectoral cost structure as far as possible and the relevant patterns of sales and purchases. In order to fulfil this requirement, the data of individual questionnaires were aggregated and classified by the values of inputs purchased, patterns of purchases, i.e. local or imports, values of gross sales, the distribution of sales and the gross outputs of the sector. There were not sufficient data in the case of many sectors for estimating stock appreciation and the values of work-in-progress. It was assumed that any physical increase or decrease in the value of the stocks of the particular sector, during the year 1979 was insignificant. On this basis, the value of gross sales has been used for the estimation procedures in place of gross outputs. However, the value of work-in-progress could not be entered into the working sheets due to the difficulty in deriving any meaningful estimates.

The final step, which was the most important issue of the survey, was to gross up the observed data for the test population. This has been done by sectors based on the following formula.

$$O_i = \frac{o_i}{e_i} \times E_i$$

where O_i = the gross output of "i"th sector of the test population

o_i = the gross output of "i"th sector of the survey

e_i = the number of employees in "i" sector of the survey

E_i = the number of employees in "i" sector of the population

The latest employment data available for the whole test population was for the year 1978. It was assumed therefore, that there were no significant changes in employment during the year 1979, so that the employment data for 1978 were used for the year 1979 without any adjustments. Secondly, it was assumed that the figures for labour productivity obtained from the sample survey would be fairly representative for the population. However, those aspects will be discussed further in the following chapters.

Finally the experience of survey work in the Tayside Region suggested that it was extremely difficult for an individual academic researcher to establish a satisfactory primary data base by disaggregating the manufacturing, trade, and service sectors in the region. This task could have been easier if the researcher had been able to get assistance from the Regional authorities which have a strong influence on the business community. However, it seemed that organisations such as Tayside Chamber of Commerce have little confidence that academic researches can assist regional economic development.

There were restrictions about using the unpublished data because of reasons of confidentiality. For example, individual returns of census of employment and census of productivity can only be obtained by recognised users such as central and local government officers, under the Statistics of Trade Act of 1947. Given these limitations of data and constraints of resources, the most suitable way to obtain the primary data base was the postal survey. In order to overcome the problems concerning the required higher level of positive response compared to that of personal interviews, it was reasonable to expand the size of the sample, while maintaining a manageable size.

CHAPTER 6

METHODOLOGY OF THE DERIVATION OF SURVEY BASED INPUT-OUTPUT TABLES FOR THE TAYSIDE REGION

The development of the use of survey and non-survey techniques in deriving regional input-output tables has been reviewed in Chapter 4. It is clear that there are still considerable differences in the conclusions drawn from various research studies in past years. Some researchers were optimistic about the use of non-survey techniques, specifically of SLQ, and they pointed to the superiority of SLQ in terms of savings of time and financial resources. During the 1970's the RAS method has been used as a tool of estimating regional input-output tables and it has been argued that it produces a closer approximation to the actual input-output tables. However, as was pointed out in Chapter 4, considerable attention should be given to modifying some of the properties of the RAS especially when the RAS technique is applied to the construction of regional input-output tables. The present study attempts to introduce some adjustments to the RAS method in order to avoid some of the weaknesses which arise in its practical use. This modified RAS method, in the rest of the thesis, will be called "adjusted RAS" or 'ARAS'.

The purpose of this chapter is therefore to discuss the methodology involved in the derivation of final input-output tables for the Tayside Region based on ARAS technique. The modifications have been introduced to the existing RAS method firstly, in the process of reconciliation of the differences between actual and estimated intermediate inputs and intermediate outputs, caused by substitution and fabrication effects. Secondly, the cells of the structural matrix have been replaced by the actual data collected from the limited economic survey conducted in the Tayside Region. The final tables so obtained will be used for the analysis of the Tayside economy and also for the comparison of the results of the input-output tables derived using survey and non-survey techniques.

6.1 METHODOLOGICAL SEQUENCE

The methodological sequence of constructing the Tayside Regional input-output tables based on the ARAS can be outlined as follows;

i Aggregation of Scottish domestic flow matrix (industry x industry) and estimation of an aggregated Scottish direct input coefficient matrix based upon domestic flows.

ii Estimation of control totals for the gross outputs, by sector, for the Tayside Region final input-output tables.

iii Estimation of final demand sectors and primary inputs sectors.

iv Estimation of control totals for intermediate outputs and intermediate inputs as residual.

v Completion of the "rows only" and "columns only" tables, inserting into the structural matrix the actual data estimated from the direct survey.

vi Valuation of "columns only" table at producers' prices.

vii Insertion of the adjusted cell values of the "rows only" and "columns only" tables into the final input-output table.

viii Completion of the rest of the structural matrix using the Scottish direct inputs coefficients together with the control totals of the Tayside regional gross outputs. It is assumed that the Scottish direct input coefficients based upon domestic flows are applicable to those in the Tayside region.

ix Computation of V_j^* and U_i^* in relation to the structural matrix of the final input-output table.

x Comparison between U_i^* and V_j^*, and actual V_j and U_i obtained as residual after injecting final demand and primary inputs which have been estimated independently from the structural matrix. Where U_i^* = estimated total of intermediate outputs.

V_j^* = estimated total of intermediate inputs.

V_j = actual total of intermediate inputs and

U_i = actual total of intermediate outputs.

xi In order to compute necessary weights to distribute the differences of $V_j - V_j^*$ and $U_i - U_i^*$, two separate structural matrices have been prepared. In the first table which can be termed "coefficients of intermediate outputs", the row values of the cells which have been replaced by the adjusted actual figures should not be included and the sum of these values along the rows should also be deducted from the U_i. It is assumed that the remaining fabrication and substitution effects reflected in the difference of $U_i - U_i^*$, and $V_j - V_j^*$

may only occur in relation to the unadjusted cells of the structural matrix.

xii Computation of the first set of A_{ij}^{C10} which can be obtained as follows;

$$A_{ij}^{C10} = X_{ij}/U_i^d \quad \text{where}$$

A_{ij}^{C10} = coefficients of intermediate outputs.

X_{ij} = unadjusted cell values along the i^{th} row of the structural matrix.

U_i^d = actual total of intermediate outputs less the sum of adjusted cell values along the i^{th} row of the structural matrix.

xiii In the second table which can be called "coefficients of intermediate inputs (A_{ij}^{C11}), the adjusted column values of the cells should be relaxed and also, the sum of these values should be excluded from the V_j. The computation of the second set of A_{ij}^{C11} can be obtained as follows.

$$A_{ij}^{C11} = X_{ij} / V_j^d \quad \text{where}$$

A_{ij}^{C11} = coefficients of intermediate inputs.

V_j^d = actual total of intermediate inputs less the sum of adjusted values of the cells down the 'j'th column.

xiv In balancing the $U_i - U_i^*$, multiply the difference, k_i by A_{ij}^{C10} and add these values to the relevant unadjusted cells of the final input-output table.

xv In balancing the $V_j - V_j^*$, multiply the difference, k_j by A_{ij}^{C11} and add these values to the relevant unadjusted cells of the final input-output tables.

xvi The second round adjustments if needed can be made by an iterative process, i.e. by using the analyst's judgement.

The main steps involved in the construction of the final input-output tables are discussed in detail in the following sections.

6.2 ASSUMPTIONS

In the construction of the final domestic flow matrix for the Tayside Region, based upon ARAS method, the following assumptions were made;

i The Scottish input coefficients are not invariantly applicable for the Tayside Region because of the differences in the product mix, technology, productivity of labour, etc., between the two regions. It is assumed that all these variations can be classified into two categories namely, substitution effects, (R_i) and fabrication effects (S_j).

ii The effects of these two categories do not apply uniformly along the rows and down the columns. Therefore, each cell of the structural matrix has individual values for R and S.

iii The share of fabrication and substitution effects for each cell of the sector depends on its contribution to the total intermediate inputs and the total intermediate outputs respectively.

iv It is assumed that there is a positive correlation between the level of consumption of finished goods by the regional industries and the effects of substitution. It is assumed that this situation is also true for the supply side.

v In order to estimate the R and S, for the unadjusted cells in the structural matrix, it is assumed that the pattern of sales distribution and the purchase of inputs in Scotland is applicable for that of Tayside Region.

vi R and S are two complete matrices.

vii $R_{ij} > 0$, and $S_{ij} > 0$.

viii R_{ij} and S_{ij} are applicable for only unadjusted cells, X_{ij} of the structural matrix.

R_{ij} and S_{ij} are calculated as follows;

$$R_{ij} = K_i \, A_{ij}^{C10}$$

$$S_{ij} = K_j \, A_{ij}^{C11}$$

In matrix notation,

$$R_{nxn} = K_i \, A_{nxn}^{C10}$$

$$S_{nxn} = K_{\bar{j}} A^{C11}_{nxn}$$ where $K_{\bar{i}}$ and $K_{\bar{j}}$ are diagonal matrices.

The values so estimated are added to the relevant unadjusted cells of the final domestic flow matrix for the Tayside Region.

This procedure does not require such a large number of iterative adjustments as the RAS method. This is mainly because a considerable number of cells in the structural matrix have been replaced by actual survey data which cover possible variations between Tayside and Scotland in terms of substitution and fabrication.

6.3 AGGREGATION OF THE SCOTTISH DOMESTIC FLOW MATRIX

The Scottish Domestic Flow Matrix, industry by industry, for the year 1973, was chosen for the aggregation primarily because of the difficulty in making the necessary data available for the industrial classification by commodities. It was assumed that any individual firm produces only one kind of commodity. However, when firms were involved in multi-product lines, all products were grouped under the main product of the firm. The industrial classification used in Chapter 4 was not applicable to the aggregation of the Scottish Domestic Flow Matrix, since the sectoring scheme followed in the Scottish Total Flow Matrix, commodity by commodity, and the Domestic Flow Matrix, industry by industry, shows considerable variations. Therefore a separate system of industrial classification was used in this stage of aggregation and this is given in table 5.2.

The major aim of the aggregation of this Scottish table was to obtain the relevant coefficients for the structural matrix of the final Tayside input-output tables when the actual data were not available. The theoretical aspects of aggregation were discussed in the previous chapters.[1] The system put forward in Chapter 4 was used for the aggregation of the above national matrix. The table of direct input coefficients was then compiled from the aggregated Scottish Domestic Flow table.

6.4 ESTIMATION OF CONTROL TOTALS

The control totals of gross outputs by sectors were derived primarily from the sample survey. It was assumed that the average pattern of purchase of inputs and the sales distributions of the sampled establishments should be applicable for the sector as a whole. This assumption has been criticised. Bulmer Thomas, for example, has clearly opposed this assumption as "there are no grounds whatsoever for believing that the unsampled part of the population distributes its output to other sectors in the same proportion as the sampled part".[2] It seems that his criticisms are too rigid to be considered in relation to an attempt to construct regional input-output tables, given the constraints of time and resources. However it is clear that the weakness of this assumption lies not in the sampling methodology, but on the way in which the sample has been drawn.

The important factor in sampling, for the purpose of estimation of parameters for the sectors, is that the sample should be drawn

---

1. For details see Stone, R. Input-Output and National Accounts OEEC, 1961.

2. Bulmer Thomas, Valuation of Transactions in Input-Output Tables, Journal of Economic Studies, Vol. 5, 1978, p.7.

representing major characteristics of the regional economy and of each sector. On this ground, the assumption that the sampled data can represent the unsampled part of the sector can be justified. The sampling for the present study has been carried out taking the aforesaid factor into account. The sample data were grossed up for the estimation of values, not only for the sectoral gross outputs, but also for the values of sectoral exports, imports, inputs purchased, labour productivity and other values added.

6.4.1 SOURCES OF DATA AND METHODS OF ESTIMATION OF CONTROL TOTALS FOR GROSS OUTPUTS

Agriculture

This sector includes agriculture, horticulture and forestry. The only source of data was the secondary data collected from the published literature. During this process, data from the Economic Report on Scottish Agriculture in 1980, the Occasional Papers of Economics and Farm Business Management,[3] the Forestry Commission, 60th Annual Report and Accounts; Tayside Potential for Development[4] and the Scottish Abstracts of Statistics were incorporated.

A problem arose in using the published agriculture statistics. The figures published in these reports for agriculture included dairy

3. See especially Anderson, J.L. Profitability of Farming in South East Scotland, 1979/80, East of Scotland College of Agriculture, May, 1981.

4. H.M.S.O. Tayside Potential for Development, University of Dundee, 1970.

producers, livestock production, fruits and vegetables which were treated under a separate sector namely "food products" according to the MLH of SIC, and the sectoring system of the Scottish Input-Output Tables. For the Tayside input-output study, the gross outputs of wheat, barley, potatoes and oats were included in the Agricultural Sector. The gross outputs of fruits, dairy products, vegetables and livestock products were transferred to the food products sector. However, some of the information provided by these published sources could not be used meaningfully for the Tayside Region because of the problem of differences in sector classification.

Forestry

In 1979, 60 per cent of the land used for forestry in Scotland was under the Forestry Commission while the other 40 percent of land was under private ownership. It was assumed that this pattern of land use would be applicable for the Tayside Region. The production of timber by the forests owned by the Forestry Commission in Tayside Region was 57,000 cu.meters in 1979.[5] The sales income of timber in the public sector has been estimated at £983,000.[6]

In the absence of accurate data, it was assumed that the productivity of forest land under the public sector would be applicable to the private sector. The total income received from the forestry

---

5. See Forestry Commission, 60th Annual Report and Accounts 1979/80, p.79.

6. According to the accounts of the Forestry Commission, the sales income of timber received per cu.meter was £17.25 in 1979. The timber sold included trees sold standing and trees converted into intermediate products such as round timber and saw logs, telegraphs and other selected poles, pulpwood and board mill material, fire wood and poles sold in length.

industry was therefore estimated at £1,638,283 and this figure has been included for the Agricultural sector.[7]

Fishing

The definition of the gross output of sea fishing industry was the amount of fish landed in Tayside and outside the region by Tayside owned vessels. The amount of fish landed outside the region by Tayside owned vessels was taken as an export of the Tayside fishing industry and the amount of fish landed in Tayside by the vessels owned by outsiders was taken as imports. The statistical data on fishing were obtained from the Scottish Sea Fisheries Statistical Tables - 1979, which cover the value and quantity of fish landed in Arbroath District.[8] The other important area of the fish industry in Tayside was fresh water fishing which included salmon, grilse and sea trout. The total quantity and value of fresh water fishing in Tayside was an estimate based on the statistics published in the "Fisheries of Scotland, Report for 1980".[9]

---

7. Income received per hectare of forestry land was estimated to £23.60 based on the statistics provided by Forestry Commission. The total land used for forestry in Tayside in 1979, was as follows;

   Amount of land used by F.Commission = 41677 hectares
   Estimated amount of land used by private woodlands = 27765 hectares
   Estimated income received from private woodlands = £655,254

8. The figures for Arbroath District covers Dundee, Arbroath, Montrose, Johnshaven and Gourdon.

9. H.M.S.O. Fisheries of Scotland, Report for 1980.

Quarrying and Oil Exporation

Data for this sector were obtained from the direct survey which covered 50% of employees in the quarrying and oil exploration sector. It was found that nearly 50% of the output of this sector came from North Sea Oil exploration work. The income received from this oil exploration work has been considered as part of the exports of the region. Due to the difficulty of making available necessary data for inventory changes and work-in progress, the value of the gross sales has been assumed as the gross output of the sector. The sampled data were grossed up to estimate the sectoral gross output on the basis of the number of employees in the sector.

Oil Products and Chemicals

This sector consists of the firms who supply goods and services for the North Sea Oil operation and the firms who produce chemicals and allied products. The collected data from the direct survey were grossed up to estimate the sectoral output.

Food Products

This is a very heterogeneous sector which covers eleven MLH of the Standard Industrial classifications. The sources of information were partly the direct survey and partly the published data. The data for the vegetables, fruits, dairy products and livestock were obtained from the Agricultural Statistics for 1981 and the Scottish Abstracts of Statistics for 1981. The postal survey provided the statistics for the remaining sub-sectors. For these sub-sectors, the sampled data were grossed up, to estimate the total gross outputs.

Brewing, Soft Drinks and Other Spirits

The values of gross outputs and other information were obtained from the sample survey and personal interviews. Local newspapers, published business registers and the literature published by the Dundee Chamber of Commerce and Tayside Regional Council were also helpful in checking their consistency. The data so obtained were grossed up to estimate the control totals of the sector as a whole.

Mechanical Engineering and Electrical Engineering

Data were obtained for these two sectors from the direct survey. The survey data were grossed up to estimate the control totals of gross outputs. The disaggregated sales values for the intermediate sectors could not be estimated from the survey data and therefore some adjustments had to be made to distribute the given figures for total intermediate outputs. It was assumed that the percentage shares of distribution of intermediate outputs of mechancial engineering and electrical engineering sectors in Scotland for their intermediate sectors were similar to those of the Tayside region. The value of total sales was then distributed for the intermediate sectors, pro-rata to the sectoral contribution to the total intermediate outputs.

Instrument Engineering

Manufacture of watches and clocks, surgical appliances and other scientific and industrial instruments are included in this sector. The main producer of watches in the U.K. was in the Tayside region in 1979. The survey could not cover a significant proportion of this industry in terms of employment; so the primary data were supplemented by the information collected from the published sources. These data were grossed up to estimate the control totals.

Metal Products

This sector includes metal manufacturing industries such as iron castings, aluminium and aluminium alloys, copper, etc. and metal goods producers such as small tools, bolts, nuts, cans and metal boxes, etc. Data were primarily obtained from the direct survey and these data were grossed up to obtain the control totals of the sector.

Textiles

This sector consists of jute spinning and weaving woollens, carpets and other textile industries. Data were obtained mainly from the sample survey. These data were supplemented with data from published sources such as local newspaper, published company accounts and reports.[10] The collected data were grossed up for the estimation of control totals of sectoral gross outputs.

Clothing

This sector includes the dressmaking industry but excluded the footwear industry. This is because there are no indications of the existence of a footwear industry in the Tayside Region in the

10. The studies of the jute industry carried out by McDowall, S., and Draper, P. Trade Adjustment and the British Jute Industry: A Case Study, The Fraser of Allander Institute, Research Monograph No.5, 1978, and Howe, W.S. The Dundee Jute Industry: An Economic Organisation Study, Aberdeen University Press, 1982 were also useful.

statistics provided by the Department of Employment. Data for the estimation of control totals were obtained from the sample survey and they were grossed up to estimate the sectoral totals.

Building Materials and Timber Products

Data for the estimation of control totals of these two sectors were not available from the sample survey. The technology and the patterns of distribution of the finished products of these two sectors have not changed much over the last 20 years in the Tayside Region.[11] This was also true for Scotland as a whole. Therefore there were reasonable grounds for believing that the Scottish input coefficients and the productivity of labour would be applicable to the Tayside Region. The gross outputs of the building materials and timber products sectors of Scotland in 1973 were inflated by the wholesale price index to obtain the relevant figures for the year 1979. The control totals for the gross outputs of these two sectors of the Tayside Region were estimated as follows;

$$\left.\begin{array}{l}\text{Gross output of timber}\\ \text{products in Tayside}\\ \text{Region}\end{array}\right) = \frac{\begin{array}{l}\text{Value of gross}\\ \text{output of timber}\\ \text{production in}\\ \text{Scotland}\end{array}}{\begin{array}{l}\text{No. of employees}\\ \text{in timber products}\\ \text{in Scotland}\end{array}} \times \begin{array}{l}\text{No. of employees}\\ \text{in timber products}\\ \text{in Tayside}\end{array}$$

---

11. This has been revealed by George Donaldson, Chairman of The Timber Research and Development Association. See Dundee Tayside, Autumn, 1979.

Company reports and accounts for a few large establishments in these two sectors were also helpful in collecting information.

Paper, Printing and Publishing

This sector includes printing and publishing of local newspapers, periodicals, cards, etc., and manufacturers of paper products. Data were mainly obtained from the direct survey. The data included figures for control totals of gross outputs, imports, exports, inputs and intersectoral sales distributions, investments, etc. The survey data were grossed up for the estimation of control totals and other sectoral values.

Construction

The value of the gross output of construction is the total of the value of new work completed during the year, income from repairs and maintenance, and the value of sub-contract works. This sector includes the construction work undertaken by the private sector contractors and the local government construction departments. The figures for the output of private sector construction work were estimated based on the sample survey. In estimating the output of public sector construction work, the Scottish Abstract of Statistics, 1982,[12] and the Annual Accounts, 1980, of the Tayside Regional Council were incorporated. The Tayside Regional Council provided information on the value of the output and on the number of employees in this public sector construction work.

12. See page 108.

Utilities

This sector consists of gas, electricty and water. The water supply for Tayside Region is undertaken by local government and the respective accounts are shown in the annual accounts of Tayside Regional Council. Therefore the water supply has been excluded from the sector utilities. Other utilities such as coal and oil have also been excluded from this sector and included in the distributive trades sector. The electricity supply and expenditure were estimated taking the receipts and expenditure pattern of the North of Scotland Hydro-Electric Board into account. Based on these figures the sales revenue obtained from the Tayside Region has been estimated. The sales revenue of gas[13] was also estimated based on the information published by Scottish Gas. The figures for inter-sectoral sales distribution of utilities except for the sectors; agriculture, fishing, ship building, clothing, binding materials, timber, and rubber and plastic products, were obtained from the sample survey.

Transport

This sector includes rail, sea (harbour, ports) and road transport. Air transport facilities on a business scale, were not available in the Tayside Region in 1979. This sector also excludes transport which is undertaken by local government since these accounts are included under Local Government. Data were obtained primarily from the sample survey and these data were supplemented by transport margins allocated from other sectors. The sampled data were

---

13. See page 116 of the Scottish Abstract of Statistics, 1982.

grossed up for the estimation of control totals of this sector.

Communications

This sector includes the Dundee Post Office and the Dundee British Telecommunications services. The data on expenditure and receipts of British Telecommunications in Tayside were obtained from a personal interview. The Tayside Post Office was not co-operative in disclosing their statistics. The share of the post office in the total output of communication was nearly 50% in terms of employees. The receipts of the postal service in Tayside have been estimated based on the Scottish total receipts of the postal service in Scotland weighed by the number in employment.[14] In estimating the expenditure it was assumed that the patterns of purchases by the post office service in Scotland for 1979, would be applicable to the Tayside Region.

Finance Services

Insurance, banking and other financial institutions are included in this sector. The gross output of the sub-sector banking is net of benefits paid in terms of interest earned. The gross output of insurance is net of claims paid for insurance policies in terms of the value of the annual receipts from insurance policies. It

---

14. Total receipts of postal service in Tayside = $\dfrac{\text{Total receipts of postal service in Scotland}}{\text{No. of employees in postal service in Scotland}}$ x No. of employees in postal service in Tayside

For further details see the Scottish Abstract of Statistics 1982, p.134.

is clear therefore that the receipts of the financial services as a whole, vary according to their activities. However the expenditure pattern of the whole sector has some similiarities so the gross output of financial services has been estimated from the expenditures. There were two ways of obtaining data. First, the sample survey provided data directly for the finance services, and these data could be supplemented with the data provided by other sectors. Second, the control total of finance services of the Scottish Input-Output Tables could be adjusted for that of Tayside Region. Since the survey data were not representative, it was found that the latter procedure could produce a more consistent set of data for the output of the financial sector. The value of output of the finance services in the Scottish Input-Output Tables in 1973 was weighted by the price index to obtain the appropriate value for the year 1979. Based on the number of employees in the finance services in Tayside and Scotland, the control total of the gross output of this sector in the Tayside Region has been estimated.

Professional and Other Business Services

This sector includes highly heterogeneous sub-sectors such as the accounting, legal, entertainment and other business services. Because of its size and nature, this sector was not included in the survey. It was assumed that the Scottish input coefficients would be applicable for those of Tayside Region. The gross output of professional and other business services in Scotland in 1973 was inflated for the year 1979, and then weighted in terms of employment in order to estimate the gross output of this sector in the Tayside Region. However, most of the cells of the column of this sector in the structural matrix of the Tayside Input-Output table have been given adjusted data from the other sectors of the sample survey.

Distributive Trades

This sector consists of wholesale and retail distributors. Data were mainly obtained from the direct survey and covered nearly 4.4 percent of regional distributors in terms of employees. The value of gross output was defined as the gross income less the value of goods bought for resale. The data collected from the sample were grossed up to estimate the values for the whole sector, assuming that the parameters of the sampled part would be similar to those of the unsampled part of the sector. The estimation of separate margins for retail and wholesale distributors by sectors was not possible due to lack of data. However, it was found from the survey returns that the average margin of the distributive trades in the Tayside Region was in the range 20 to 25 percent.

Local Government

Data on the income and expenditure of local government were obtained from the published annual accounts of the Tayside Regional Council for 1980. "Rating Review, 1979"[15] and the Scottish Abstracts of Statistics, 1981 were also used in gathering information for local government. Nearly 66.6 percent of total income of local government came from central government as rate support grant and 27.2 percent of income came from domestic

15. Rating Review, 34th year of issue, June, 1979.

subjects, i.e. households. The income received from intermediate sectors of the region was nearly 6 percent. There were no clues given on how to distribute this amount of income along the local government row. General rate depends on property assessments. However, more disaggregated data in relation to the Tayside Input-Output Tables are not available. It was therefore assumed that the rate income received from the intermediate sectors would largely be dependent on their contribution to the total regional gross outputs. On this basis, the sectoral income of the local government has been estimated as follows;

$$\text{Income received from sector } i = \frac{\text{Gross output of sector } i}{\text{Total regional gross output}} \times \text{Total income received from intermediate sectors.}$$

Household Sector

In most input-output studies household income is included in the final demand sector. However, it is frequently treated in the regional economic planning models as an industry. Households do in fact sell labour, managerial skills and privately owned resources and they receive in payment wages and salaries, dividends and rents, proprietors' income, etc. To provide these resources they buy food, clothing, automobiles, housing services and other consumer goods. One of the prime objectives of regional planning is to examine the pattern of regional income and employment, and to explore necessary policies in order to direct them into appropriate paths. There are two main advantages in treating households as an industry. Firstly, it reflects the linkage relationships between the household income and industrial outputs. Secondly, planners can compare regional income multipliers and employment multipliers which help them to analyse the multiple effects of enhancing or retarding the level of regional income and employment upon the rest of the economy.

The gross output of this sector has been estimated including the income received from employment, government payments such as supplementary benefits, child benefits, pension payments, etc., and other incomes such as rents, and those from self employment, etc. The figures for employment income were estimated from the sample survey. The central government payments to the household sector were estimated based on the information published in the Scottish Abstract of Statistics. It was assumed that the pattern of household savings in Scotland would be applicable to the Tayside Region. The figures of Scottish savings were obtained by deducting consumers' expenditure in 1979 from the personal disposable incomes. The cell values of the household column were partly obtained by the sample survey and partly by the published sources.[16] The rates and rents paid by the households to local government were directly obtained from the Local government annual accounts for the year 1979. The Scottish figures on income taxes of households were adjusted for the Tayside Region in terms of number of working population in the two regions, Scotland and Tayside, respectively, assuming that the Scottish pattern of household tax payments would be applicable to Tayside.

16. The figures for personal expenditure in Scotland published in Regional Trends, CSO, 1982, and Scottish Abstracts of Statistics, 1982 were used. These Scottish figures were adjusted for the Tayside Region based on number of population.

6.5 ESTIMATION OF FINAL DEMAND SECTORS AND PRIMARY INPUTS SECTORS

6.5.1 FINAL DEMAND SECTORS

The detailed disaggregation of final demand sectors depends on the amount of data available and the relevance of the disaggregated categories to the economy under consideration. The survey returns facilitated the listing of the value of exports, and fixed capital formation which includes additions to the fixed capital during the year, and physical appreciation of the value of stocks. The published data were available for the estimation of central government expenditure. The main source of information was the Scottish Abstract of Statistics, 1982. The data on government expenditure on households were obtained from Scotland as a whole and they were weighted by the number of population in order to estimate the relevant figures for the household sector in Tayside. Government expenditure on manufacturing and other business sectors was also estimated based on the Scottish figures. The assumption made was that the pattern of government expenditure in Tayside would be similar to that of Scotland.

The values of exports by sectors were obtained from the survey. Data on imports and exports were also collected from personal interviews with the officials of the Port Authorities in the Tayside Region and from secondary sources. It was found that the data gathered using the later method were inconsistent and that there were large discrepancies, when compared to the survey figures. The main reason was that the ports in Tayside undertook imports and exports not only for the Tayside region but also for outsiders.

It was also the case that the goods of the Tayside region were exported by ports outside the region. This was also the case for imports. However data were not available to quantify the value of imports and exports of the Tayside Region through the ports outside the region. On the other hand, data could not be made available for the exports of goods of the region to the rest of Scotland and the U.K., which were transported by road and rail. Because of the difficulty in quantifying accurately the value of imports and exports of the region from the secondary sources, it was assumed that the sampled data on exports and imports could be applied to the unsampled parts of the sectors.

On the valuation of exports, there were some problems experienced which need a brief explanation. The goods exported to the rest of Scotland and the U.K. could be valued at producers' prices. In other words the transport and distribution costs associated with these transactions have not been considered. The goods exported through the ports could be valued at f.o.b. (free on board) prices, so that the transport costs and distributions costs that occurred from factory to port could be allocated to the rows transport and distribution respectively. However, in the absence of data to disaggregate exports by their destinations, all exports from the Tayside Region had to be valued at producers' prices.

The column of exports in the final demand includes the value of outputs sold to tourists which amounts to nearly £52 million[17] per year in the Tayside Region. Information about tourist expenditure was obtained from the Tourist Section of Tayside Regional Council,

17. Annual Report, Scottish Tourist Board, 1979.

Annual Reports of Scottish Tourist Board, and other published reports.[18] It was however, difficult to obtain accurate data for the sectoral contributions to tourism. Hence, the total tourist expenditure in 1979, was equally distributed to the sectors, i.e. food products, distributive trades, and professional and other business services. The earnings of households from tourism, which has been estimated at £20,211,000[19] were included in the household row under exports.

6.5.2 PRIMARY INPUTS:-

This sector includes, imports, subsidies, payments to the government, retained eranings and depreciation, and they appear in the Tayside input-output tables under three headings, namely imports, subsidies and other value added. The reason for the aggregation of government payments, retained earnings and depreciation is the problem of making the required amount of data available. The method of estimation and valuation will be discussed for each sector.

Data for the imported goods were collected from the sample survey. Assuming that the pattern of the imports of the sampled part of the sector would be similar to that of unsampled part, the collected data were grossed up to obtain estimates for whole sectors.

---

18. "The Economic Impact of Tourism; A Case Study in Greater Tayside", (ed) Coppock, J.T, et al, Research Report No.13, University of Edinburgh, 1975.

19. This has been estimated based on the number of employees in the tourism sector, i.e., 4250 (full-time equivalent), and on their average weekly earnings.

The distinction between competitive and non-competitive imports has advantages in regional planning. In the industrial development programmes, it is the common practice to give priority to these sectors which produce goods to compete with imports at less cost. On the other hand the identification of non-competitive imports facilitates more accurate estimates of regional technical co-efficients. Hence, the forecasting, impact analysis and multiplier analysis which are carried out based on these technical co-efficients should have produced more acceptable results.

The non-competitive imports could enter into the table as a single row in the section of the primary inputs. They can be valued at c.i.f. (cost, insurance and freight) price plus transport and distribution costs which occurred during the transport of goods from the port to the factory and any import duties. In valuing at producers' price, the margins could be deducted and allocated to the distribution and transport rows respectively. However, in this way, the non-competitive imports could not be valued purely at producers' prices, since they include import duties which cannot be identified individually.

The competitive imports could be included in the structural matrix together with their domestic substitutes, and they can be distinguished in the final demand by subtracting the total value of competitive imports (**i**) from the row (i).[20]

---

20. For details see Isard, W., and Langford, T.W. "Regional Input-Output Study: Recollections, Reflections and Diverse Notes on the Philadelphia Experience," M.I.T. Press, 1971 pp. 114-123, and McNicoll, I.H., Some Aspects of the Impact of Oil on the Shetland Economy, Unpublished Ph.D Thesis, 1977, pp 44-46.

This is the more conventional method of treating imports. However, in practice, the distinction between competitive and non-competitive imports may not be made. The problem which arose in compiling the Tayside input-output tables was that the positive respondents of the survey could not distinguish imports as competitive and non-competitive. Therefore, data were not available for this purpose. In order to overcome this problem it was assumed that all imported goods in the Tayside Region were non-competitive imports, i.e. there were no domestic counterparts, so that all imports were included in a single row under the primary inputs. However, it should be mentioned that there were as many competitive imports as non-competitive imports mainly because of openness of Tayside to foreign markets. Therefore, there may be some errors in the input coefficients in the structural matrix.

Data for the subsidies were mainly gathered from the published sources. The Scottish Abstracts of Statistics lists subsidies given to the individual sectors in the year 1979.[21] The shares of subsidies disaggregated into sectors of the Tayside Region have been obtained as follows:

$$TVS_i^{Ty} = \frac{TVS_i^{SC}}{E_i^{SC}} \times E_i^{Ty}$$

where TVS_i^{Ty} = Total value of subsidies given to the i th sector of Tayside

TVS_i^{SC} = Total value of subsidies given to the i th sector of Scotland

21. See Table 15.9 "Identifiable Public Expenditure in Scotland: Analysis of Data of Table 15.1 by economic category" Scottish Abstract of Statistics, 1981 , p.198.

E_i^{SC} = Number of employees in the i th sector of Scotland and

E_i^{Ty} = Number of employees in the i th sector of Tayside

The assumption made in following this formula was that the amount of the subsidy given to an individual sector is dependent on the number of its employees.

One way of estimating the company taxes paid by establishments in Tayside was to scale down the published data for Scotland. The Scottish Abstract of Statistics, 1981 provides the value of company taxes for Scotland for 1979. The share of company taxes in Tayside could be estimated using the number of employees in the two regions. The gross figures so obtained could be disaggregated into the individual sectors based on sectoral employment, assuming that the amount of company tax depends on the number of employees in the sector. However, it was found that the above procedure could not produce a very close approximation to the actual figures primarily because of the fact that some establishments in the Tayside Region were receiving 'Special Development Area" status. The establishments which had started their businesses under the privilege of this status were being exempted from company taxes. However, accurate data on this scheme could not be obtained from the Inland Revenue Department in Tayside.

The company taxes and company profits therefore, were derived on the basis of the sample survey. The consistency of the survey figures could be checked, to a certain extent, with the estimated published data. The estimated published data could also be used for the commercial services, agriculture, fisheries, building materials and timber products, for which survey data were not available.

It was found that nearly 83 percent of inland revenue in Scotland came from personal income, while only 12 percent was in the form of corporation tax.[22] Taxes paid by the households of Tayside were estimated taking the size of the active working population of Scotland and the Tayside Region, and the total value of income tax paid by all Scottish households into account.[23] In this way income taxes paid by Tayside households was estimated as follows;

$$TIT^{Ty} = \frac{TIT^{SC}}{AWP^{SC}} \times AWP^{Ty}$$

where TIT^{Ty} = Total amount of income tax paid by Tayside households

TIT^{SC} = Total amount of income tax paid by all Scottish households

AWP^{SC} = Size of the active working population in Scotland and

AWP^{Ty} = The size of the working population in the Tayside region

The figure so estimated has been included in the tax and other value added row under the household sector.

---

22. See table 15.13 of the Scottish Abstract of Statistics, 1982

23. The active working population includes employees and employers, the self-employed, and those who receive dividends, rents and other unclassified income; but it excludes the number of unemployed.

6.6 INCLUSION OF ACTUAL VALUES INTO THE STRUCTURAL MATRIX

The survey data collected for inputs purchased and outputs sold by the individual sectors have been grossed up for the sectors. In order to feed these values from the working sheets into the regional input-output table, two separate tables, namely "columns only" and "rows only", were prepared. The direct and indirect inputs[24] purchased by the sector i were allocated into the relevant column of the sector i of the "columns only" table. The inputs purchased by the food products sector, for example, were fed into the column of this sector. The primary inputs were also injected into the "columns only" table. The sales of sector i appearing in the working sheets were allocated into the respective row of sector i of the "rows only" table. There are two advantages of preparing two separate tables prior to the final table. Firstly, it enables a unique valuation system for the whole table to be followed and secondly, it provides an opportunity to carry out consistency checks for the observed figures.

The sample survey has been able to fill 308 cells with observed data. This amount represents 35 percent of the Tayside Region Domestic Flow matrix. More than 90 percent of the cells which contain observed data are in the lower part of the matrix (including primary inputs).

24. The direct inputs are the goods or services that contribute to the production of goods or services. Indirect inputs are the goods or services which are not directly associated with production. These inputs include goods or services associated with the upkeep of machinery, factory and office maintenance, etc.

This indicates the fact that the survey, regardless of primary inputs and final demands, has been successful in collecting data for indirect inputs such as utilities, transport, distribution, etc. The main reason for the lower level of representation of the upper part of the structural matrix is that many firms in the Tayside Region do not buy a considerable amount of their direct inputs from the regional industries. For example, the sector brewing, soft drinks and other spirits, imported all of its barley requirements in 1979 while the Tayside Region exported more than twice the amount of barley required for the regional brewing, soft drinks and other spirits industry.[25] As a whole, over 90 percent of regional sectors imported more than 25 percent of their direct inputs in the year 1979, so keeping the upper part of the structural matrix with many empty cells. On the other hand, even when firms bought their direct inputs from the regional industries, some respondents could not disaggregate them by sectors. In this case the aggregated figures were distributed assuming that the Scottish pattern of intra-sectoral purchase disclosed in the Scottish Input-Output Tables 1973, would be applicable for the Tayside Region.

6.7 VALUATION SYSTEM ADOPTED IN THE TAYSIDE INPUT-OUTPUT TABLES

In order to reflect uniformity of the values of each cell, the rows and columns of the input-output table should be valued at one price. There are three systems of valuation available, namely, producer's price, purchaser's price and basic price. In valuing

---

25. Findings of the personal interviews and the sample survey.

the cells at producer's price, every item of inputs should be inserted into the tables deducting distributor's, retailer's (if any) and transport margins. The deducted values should then be allocated to the respective rows of distribution and transport. However, the value of indirect taxes remain in the cells when they are valued at producer's price. In this system input-output tables indicate the values producers receive. The values of sales remain as they are, but it is assumed that the sales values are net of transport and distribution costs.

In valuing at purchaser's prices, it is assumed that the inputs are recorded as the purchasers pay for them. The sales of finished goods include distributors and transport margins. In this process the distributors' transport margins and other taxes are added to the sales values, if these cost items are recorded individually in the questionnaire returns. The basic values, on the other hand, are the producers' prices, net of commodity taxes. Indirect taxes so deducted could be illustrated in the input-output tables separately. It has been argued that the basic prices were the appropriate way of valuing the input transactions.[26] However, in the absence of accurate data on indirect taxes on inputs purchased, this method could not be used in the present input-output tables.

The sample survey of Tayside revealed that the purchase of inputs could be identified from the survey returns more satisfactorily than the pattern of distribution of finished goods or services.

---

26. Jensen, R.C., Mandeville T.D., and Karunarathe, N.D. Regional Economic Planning, London, 1979, p.49.

This situation led the researcher to prefer the valuation of transactions of Tayside input-output tables at producers' prices. The other reasons for not using the purchasers' prices is that they include trade and transport margins and they may vary from one user to another. It should be noted however, that whatever the price system adopted, errors may arise due to the different levels of margins paid by purchasers.

In the sample survey, most of the inputs purchased were given inclusive of transport and distribution costs. The sales figures were given exclusive of transport and distribution margins. The values of direct taxes were given separately. It was assumed that this pattern would be applicable to the unsampled part of the sectors. Having decided the price system (for the valuation), the next step was to identify the distributors' and transport margins.

The distributive trades included wholesale and retail distributors. The wholesale margins were defined as the gross sales less the value of goods purchased for resale. Since this margin was varying from sector to sector, the relevant wholesale margins should have been obtained separately from the survey for each manufacturing sector. Nearly fifty wholesale and retail establishments were surveyed. Only eleven distributors representing nine sectors replied. Therefore, it was assumed that the margins estimated from these returns were applicable for the unsampled distribution establishments and also to the non-respondents of the sample survey. For the rest of the manufacturing sectors specifically, it was assumed that the Scottish wholesale margins would be applicable.

The primary data collected from the survey allowed transport margins to be estimated for individual sectors by using their survey returns directly. It was also possible to derive the transport margins by considering the transport as a separate sector within the structural matrix. The primary data needed for both purposes were available to a certain extent. However, it should be pointed out, that the collected primary data were not able to produce completely accurate estimates for transport margins since detailed information on costs associated with different modes of transport could not be made available.

A problem arose in estimating transport margins when the establishments had their own transport systems. This was particularly true in relation to the large and to most of the medium sized establishments in the Tayside region. In general, the transport costs obtained via the sample returns consisted of the values spent for external transport services. Telephone enquiries made to respondents revealed that some firms used external transport for the purpose of bringing the inputs to their factories while they used their own transport for the distribution of finished products. Some revealed that they used their own transport for both purposes. The most crucial problem, when the establishments have their own transport system, was that the cost involved with this service could not be identified. The reason was that the cost of transport in this case, was included in the accounts under different categories such as cost of vehicles, cost of maintenance, labour, oil, etc.

A possible way of solving this problem was to contact all respondents and to obtain the actual transport margins for each establishment. Then an average figure could have been estimated.

However, this method could not be followed in the present study because it would be too time-consuming. Also these margins could be compiled using data from the transport sector, which was included in the survey. It provided the values of transport services given to the industrial sectors and to the final demand sectors. The margins so obtained could be compared with the data on transport cost given in individual sample returns. However, this procedure was not able to provide a close approximation to the actual figures. This was because the margins provided by the transport sector might also include the transport cost of delivering raw materials to the firms and of delivering finished products from the firms. Also it did not take into account the situation when the firms had their own transport systems.

The estimation of transport margins in the Tayside input-output study was based on two assumptions. First, it was assumed that the transport costs given by the individual establishments were associated only with the transportation of raw materials. Second, when firms have their own transport system, the cost associated with this operation has been excluded from the adjustments of transport margins by assuming that these costs were intra-firm transfers.

Having obtained the margins, the next step was to adjust each cell down the columns of the structural matrix. First, the retail margin was adjusted. This margin was applied mainly for the households column. For the remaining sectors the retail margin was not computed assuming that they may buy their inputs not from retailers but from wholesalers, because of their bulk requirements of inputs. Secondly, the wholesale margins were deducted from the input cells and were allocated them into the distribution row. Finally, the transport margins were adjusted as discussed before.

There were some other paradoxical situations in adjusting wholesale and transport margins which it seems worthwhile to discuss briefly. It was found in some cases, that the transport costs were included in the wholesale margins especially when the wholesalers undertook the delivery of inputs. Here the adjustments to transport margin, without close inspection, may cause double counting errors.

On the other hand when the inputs were imported the transport costs could be incurred on two occasions, i.e. transport cost for delivering goods from ports to the distributors and secondly, delivering goods from distributors to the manufacturers. It was assumed in the present study that the transport costs which occurred from port to distributors should be included in the wholesale margins. The transport costs of delivering goods from wholesalers to the manufacturers had to be treated in two ways because this cost should be included in the returns of one of the parties, but not in the returns of both. When the delivery of goods was undertaken by the wholesalers then the transport margin may not be adjusted. The second situation affecting the treatment of transport cost was when the manufacturers transported their inputs from other producers or wholesalers. In this case. the treatments were similar to the procedure discussed earlier.

There may be many transactions between producers within the region in selling and buying from each other. In these transactions the distribution margin may or may not be involved in the purchasers' price. Hence the adjustments for only transport margin may require the conversion of the purchaser's price into producer's price. In practice, the adjustments for margins, discussed above, are not applicable for the commercial sectors such as finance, professional and other services, communications etc., to the same extent as they are to the manufacturing sectors. It is also the case that some proportion of the value of the cells along the main diagonal of the structural matrix is not subject to the adjustments of margins since they are the inputs purchased from the same sector in the region. However, these points could not be given further attention in the Tayside study due to the lack of available data.

It will be clear from the above that the treatments of margins are tedious and time consuming. The most important point that the above analysis on valuation of cells has put forward is that the adjustments procedures need to be flexible and designed as far as possible to match the characteristics of the study region.

CHAPTER 7

ANALYSIS OF THE TAYSIDE ECONOMY USING SURVEY-BASED INPUT-OUTPUT TABLES FOR THE REGION IN 1979

INTRODUCTION

A regional input-output study can provide an extensive primary and secondary data base for the economic structure of a particular area within a specific period. Chapter 3 analysed the main characteristics of the Tayside economy using the secondary data gathered for this study. The succeeding sections of this chapter examine the Tayside economy in relation to its survey-based input-output tables for 1979 with particular reference to an analysis of some of the theoretical and practical applications of these tables.

7.1 TAYSIDE REGION INPUT-OUTPUT DOMESTIC FLOW TABLE

Table 7.1 shows the Tayside Region Input-Output Table, Domestic Flow Matrix. This matrix consists of three quadrants. Quadrant One presents the consumption patterns of the final output of the industry. This quadrant includes the values of goods produced by the region's industries which have been delivered to government and consumers outside the Tayside economy, and values of sales on current account for capital formation. Quadrant Two, which plays the most important role in the input-output analysis, shows

Table 7.1. Tayside Survey-Based Input-Output Table: Domestic Flow Matrix for 1979 (Industry x Industry)

(£000's)

PURCHASES FROM \ SALES TO	1	2	3	4	5	6	7	8	9
1. Agriculture	4976 *	-	-	14342 *	-	149.8	-	-	-
2. Fishing	-	0.4	-	694.95	-	-	-	0.0267	-
3. Quarrying & Oil exploration	322	61.5	515	366.5	-	369	1533	159	-
4. Food Products	-	24.3	-	14165	1277	886.8	6.1	-	-
5. Brewing, Soft drinks & Spirits	-	-	-	3927	6814.8	-	-	-	-
6. Oil Products & Chemicals	2134	24.6	1246	1493	1146	8956	3619	1322	146
7. Metal & Metal Products	17.7	4.8	928	1105.7	1507	1184	130	223 *	2772 *
8. Mech. Engineering	1473 *	2.6	207	168	566	569	433	243 *	702 *
9. Instrument Engineering	1.7	0.4	17.2	19	23.3	24.2	12.1	3880.3*	1856
10. Electrical Engineering	12.2	96	15	4	21.5	8.6	79	175	88
11. Shipbuilding & Marine Eng.	-	184	1.8	-	3.6	-	-	20.8	-
12. Textiles	7.7	185	3	29.6	3	23	48.2	133.8	-
13. Clothing	0.36	1.9	1.1	22.8	2.7	10.9	1.1	9.3	0.36
14. Building Materials	14.9	-	380.6	7.6	41.2	145	668.6	79.9	79.7
15. Timber Products	17.7	3.5	646.6	190.6	948	290	170.2	391.6	47.6
16. Paper, Printing & Publishing	45.57	1.52	6.07	2278	683.6	1058 *	92 *	682 *	1085 *
17. Rubber & Plastic Products	3.3	7.96	43.3	362	325 *	700.8	57.1	188.6	118.9
18. Construction	1452	-	1121.2	432.7	7583.5	625.8	1130	655	404.5
19. Utilities	535.8	1.2	1580	549 *	864 *	4875 *	520 *	930 *	4700 *
20. Transport	395	42 *	3155	523 *	3992 *	3462 *	1921 *	921 *	1143 *
21. Communications	227	2.4	99	400 *	313 *	686 *	165 *	1436 *	1654 *
22. Distribution	3587.6	120.8	500.6	39047 *	5672	1249 *	6200 *	9640 *	14347 *
23. Finance Services	1217	110.4	860	276 *	501 *	2181 *	97 *	1685 *	5780 *
24. Professional, Business and other Services	630	1.57	620.5	429 *	1994 *	10940 *	985 *	1432 *	9007 *
25. Local Government	84.2 *	4.7 *	96.4 *	353 *	583 *	448 *	224 *	149.4*	217.3 *
26. Households	24670 *	839.4 *	25037 *	18436 *	9987 *	12682 *	14101 *	27504 *	34340 *
27. Intermediate Inputs	41825	1720.9	37080	103311.1	47009.3	51031.7	32192	51860	78488
28. Imports	5268	882.7 *	12516 *	41398 *	78965 *	179400 *	85582 *	18376 *	32804 *
29. Subsidies	-6220.7 *	-197.6 *	-55.2 *	-683.1*	-114.3*	-84.7 *	-142.9*	-304.8*	-181.9*
30. Taxes & Other Value Added	4541 *	267 *	2607.8 *	50312 *	13693 *	11303 *	3928.8*	9988 *	7862 *
	45413	2673	52149	190648	137396	241650	121561	79920	118972

* Survey data.

Table 7.1. (Continued)

10	11	12	13	14	15	16	17	18	19	20
-	-	254.3	281.5	-	1317	349.7	-	18	-	-
-	-	-	-	-	-	-	-	-	-	-
23.3	10.2	64	7.7	1476	18	330.6	269	554	9791	64
-	-	4.81	953	-	9.26	138.2	8.5	0	6.03	-
-	-	-	-	-	-	-	-	-	-	-
859	337	3764	171	130.6	276	2106	3096	1347	4121	668
142	1926	231.3	26.4	35.6	840.6	-	192	65	-	-
348	483	307	32.6	152	134	199	74	1278	260	597
308.5	12.2	26.9	28	0.63	6.6	41.5	477.6	1175 *	40.2	42.4
582	61.5	5.5	-	52.1	43.4	8.7	6.5	613	227	65.1
-	2347.4	-	-	-	-	-	-	1.8	-	310
11.2	3.3	5183.5	1381.1	68.2	277	99.7	220.8	104	-	190
0.77	5.5	253	31.8	1.55	1.5	1.9	1.9	10.1	12.7	15.6
65.6	14.7	6.7	-	65.9	86	34.6	10.6	2532.7	12.7	377.2
135.3	115.2	53.9	0.93	13.3	7432.8	604.9	36.1	1812.4	12.7	125.7
16 *	30.4	258.7 *	106.3	121.5	25.8	2855.9	182.3	97.8	121.5	45.5 *
84.3	12.2	96.36	10.4	7.6	959.7	298.5 *	57.3	398.6	80.5	455.8
260.5	78.4	530	73.08	37.5	291	795	121	63380	1334.6	5797.6 *
253 *	262.2	4124.5*	65.3	79.8	443	962.4 *	373.6	111.3 *	3702	290.2 *
808 *	93.1	4549.7*	256.7 *	235	274.1 *	4319.2 *	279.8 *	10842 *	368.8	28530 *
167 *	24.5	197.4*	43.5	12	291	351 *	55.2	219 *	375.6	1065.8 *
2000 *	166.6	4932.5*	1597.3 *	233	833.9	736.8 *	1910	19984 *	503	3965 *
8 *	208	1172.7*	185	18	622	1494.6 *	197	1817.4*	496.3	4853.8 *
117 *	166.6	832.4*	262.8	77.6	2740	6488.4 *	558	397.5*	1039	998 *
95*	45.5 *	176.5*	28.5 *	7.2*	122 *	743.2 *	40.7 *	257.2 *	122 *	1166.6
10975*	82647 *	32288.7*	5954.7 *	3187.6*	7321.6 *	16327 *	6171.4 *	75700 *	10401 *	33647
17269	14668	59314	11497.6	6013	24366.2	45918	14354	182716	33027	83270
24451 *	6662.1*	33582 *	2555.8 *	1746 *	31660	93677 *	3950.2 *	75206 *	2863	46999*
-382.9*	-95.2*	-562 *	-81.9*	-40.9*	-104.8 *	-2572 *	-81.9 *	-695.3 *	-114.3*	-700 *
9146 *	3273.9*	4026.1*	1579.4 *	1416	10265 *	33505 *	2993.1 *	8519.4 *	31290	27628 *
50484	24509	96360	15551	9134	66187	172843	21230	265746	66818	157198

Table 7.1. (Continued)

21	22	23	24	25	26	Total Inter Output	Central Govern-ment	Investment	Exports	Total Final	Total Gross
159	-	-	4.5	854	2360 *	25066	310	4805	15232	20347	45413 *
-	-	-	-	2.138	1591.5	2289	-	-	384 *	384	2673 *
25.6	51	-	2.5	1331	5288	22642	114 *	-	29393	29507	52149 *
-	-	-	94.4	743.7	24473	42790	-	2489.8 *	145368 *	147858	190648 *
-	-	-	-	-	11410 *	22152	236 *	22052 *	92956 *	115244	137396 *
331	2774	141	1854	829	71663 *	114554	175 *	13626 *	113295	127096	241650 *
17.6	-	-	81.1	77.7	-	11507	295 *	2322 *	107437	110054	121561 *
48	-	159	179.3	123	-	8737.5	629.5 *	3521 *	67032 *	71182.5	79920 *
1.3	40	0.83	25.5	4893 *	1296	14250	375.7 *	8743 *	95603 *	104722	118972 *
14.2	36.2	4.4	22.4	17.9	87.2	2346.4	790.8 *	2497 *	44850 *	48138	50484 *
-	-	-	62.7	24.2	16.1	2972	196.7 *	-197 *	21537	21537	24509 *
1.5	381.9	1.5	110.8	46.7	4335 *	12849.3	1160.6 *	3368 *	78982 *	83511	96360 *
0.36	7.4	-	17.2	5.8	956.8 *	1374.4	169.2 *	414.4 *	13593 *	14176.6	15551 *
2.7	96	0.83	59.4	66.6	-	4849.7	84.6 *	340	3860	4284.6	9134 *
1.3	655.9	-	71.7	108.8	-	13887	216.4 *	7076 *	45007	52299	66187 *
6.07	1052 *	607.6	4709.2	151.9	1209.9 *	17530	531.1 *	7106.6*	147675 *	155313	172843 *
13.5	152.8	4.17	84.9	55.5	-	4579	169.2 *	1519.4*	14962 *	16651	21230 *
116.3	2305 *	108.4	1981.7	18104.7	53954 *	162673	1435.9 *	87831 *	13806 *	103073	265746 *
29.7	9293.7*	135.5	1226.7	1051 *	30623 *	66582	236 *	-	-	236	66818 *
143.3	1805.5*	50.04	330.3	7739 *	19177 *	95356	1798 *	24731 *	35313	61842	157198 *
33.8	2959.8*	329.5	764.4	666	653.7*	13191.6	334.4 *	7242 *	-	7576.4	20768 *
244.8	203980	171	2002.7 *	2597 *	66715 *	399568	2931 *	41464 *	335971 *	380366	779934 *
136.6	3139.2*	327.4	1368.3	677.1	6144 *	35573	531.1 *	-	-	531.1	36104 *
10.3	10107 *	1322.1	5614.8	17794	96171 *	170735	33804 *	-	36094	69898	240633 *
27.1	1439.5*	38.7*	174.5 *	205 *	30183 *	37032	73975 *	-	-	73975	111007 *
113551.3	79937 *	22929 *	170480 *	49359 *	-	714091	34819 *	31108	20211	86138	800229 *
14915	320214	26331	191323	107513	428307						
1339	435311 *	2867	5954	-	108276						
-161.9	-1419.3*	-257.2*	-2591 *	-	-						
4676	25828	7163	45947	3484	262646						
20768	779934	36104	240633	111007	800229						

transactions of goods and services from the Region's industries to the Region's processing sectors. Each cell along the row of this quadrant indicates the amount of goods sold to the regional processing sectors. The values of the cells down the column show the inputs purchased by the Region's industries. In this way the value of each cell is a double entry. Quadrant Three includes the primary inputs such as imports, taxes and other value added and subsidies. One of the main features of this table is that the households are regarded as comprising a processing sector because their members sell their labour and in return they receive wages, salaries, profits, dividends, rents and other incomes. Quadrant Four which records the direct sales of primary factors to final users was not completed in the Tayside domestic flow matrix due to lack of data.

7.2 DOMESTIC FLOW COEFFICIENTS MATRIX

This matrix, which has been derived from the Tayside Region domestic flow table, shows the Region's trade coefficients[1]. This means that it presents a clear view of trade flows within the Region, and outside the Region in terms of exports and imports. However, it does not provide a complete picture of the sectoral production functions.

---

[1] The domestic flow coefficients were derived by dividing each value in a column of table 7.1 by the total inputs of the industry represented in the column.

When the production of sector i, for example, needs to be increased by one unit, the direct requirements of inputs provided by the regional industries and the outsiders also need to be increased. Table 7.2 demonstrates the direct requirements of inputs required to produce one additional unit of output which can be made available within the region and from the outside of the region.

7.3 INPUT-OUTPUT INVERSE MATRICES FOR THE TAYSIDE REGION

When the demand for goods of sector i increases by a regional sector, say j, then the sector i needs to increase the purchases of inputs from other regional sectors in order to meet the required output. In effect, sectors m which supply inputs to the sector i also need to increase their purchases from other regional sectors to meet these additional requirements. This process continues as a chain within and outside the Tayside Region. Therefore, when the final demand of one sector changes while the final demands of other sectors remain constant, it affects the level of outputs indirectly, the level of incomes, and the level of employment of all the regional processing sectors. As we have seen, this is due to inter-industrial relationships created through the processes of buying and selling from one another in the region. Table 7.3 which presents the Tayside Region Input-Output Inverse Matrix, quantifies indirect and direct effects resulting from the increase in final demand. This table was derived by using table 7.2 and the mathematical formulation involved in completing this matrix was briefly described in chapter 2. The coefficients in this table are also termed

Table 7.2. Tayside Survey-Based Input-Output Table Domestic Flow Coefficients Matrix for 1979

PURCHASES FROM \ SALES TO	1	2	3	4	5	6	7	8	9	10	11
1. Agriculture	0.1096	0	0	0.0752	0	0.0006	0	0	0	0	0
2. Fishing	0	0.0001	0	0.0036	0	0	0	0.0	0	0	0
3. Quarrying & Oil Exploration	0.007	0.023	0.0098	0.0019	0	0.0015	0.0126	0.002	0	0.0006	0.0004
4. Food Products	0	0.009	0	0.0743	0.0093	0.0037	0.00005	0	0	0	0
5. Brewing, Soft Drinks & Spirits	0	0	0	0.0206	0.0496	0	0	0	0	0	0
6. Oil Products & Chemicals	0.047	0.009	0.0239	0.0078	0.0083	0.037	0.0298	0.0165	0.0012	0.017	0.0137
7. Metal & Metal Goods Manufacture	0.0004	0.0018	0.0178	0.0058	0.0109	0.0049	0.001	0.0028	0.0233	0.0028	0.0786
8. Mechanical Engineering	0.0324	0.001	0.0039	0.00088	0.0041	0.0023	0.0036	0.003	0.0059	0.0069	0.0197
9. Instrument Engineering	0.00004	0.0001	0.0003	0.0001	0.0002	0.0001	0.0001	0.0485	0.0156	0.0061	0.0005
10. Electrical Engineering	0.0003	0.034	0.0002	0.0002	0.00015	0.00003	0.0006	0.0022	0.0007	0.0115	0.0025
11. Ship Building & Marine Eng.	0	0.069	0.00003	0	0.00003	0	0	0.00026	0	0	0.0958
12. Textiles	0.0002	0.069	0.00005	0.0001	0.00002	0.00009	0.0004	0.0017	0	0.0002	0.0001
13. Clothing	0	0.0007	0.00002	0.0001	0.00002	0.00004	0.0	0.0001	0.0	0.0	0.0002
14. Building Materials	0.0003	0	0.0073	0.00004	0.0003	0.0006	0.0055	0.001	0.0006	0.0013	0.0006
15. Timber Products	0.0004	0.0013	0.0124	0.001	0.0069	0.0012	0.0014	0.0049	0.0004	0.0027	0.0047
16. Paper, Printing & Publishing	0.001	0.0006	0.0001	0.0119	0.005	0.0044	0.0007	0.0085	0.0091	0.0003	0.0012
17. Rubber & Plastic Products	0.00007	0.003	0.0008	0.0019	0.0023	0.0029	0.0005	0.0023	0.001	0.0017	0.000[illegible]
18. Construction	0.0319	0	0.0215	0.0022	0.0552	0.0026	0.0093	0.0082	0.0034	0.0052	0.0032
19. Utilities	0.0118	0.0004	0.0303	0.0028	0.0063	0.0202	0.0043	0.0116	0.0395	0.005	0.0107
20. Transport	0.0087	0.0157	0.0605	0.0027	0.029	0.0079	0.0158	0.0115	0.0095	0.016	0.0038
21. Communications	0.005	0.009	0.0019	0.002	0.0023	0.0007	0.0013	0.018	0.0139	0.0033	0.001
22. Distribution	0.079	0.045	0.0096	0.2048	0.0413	0.0052	0.051	0.1206	0.1205	0.0396	0.0068
23. Finance Services	0.0268	0.0413	0.0165	0.0014	0.0036	0.009	0.0003	0.021	0.0486	0.00016	0.0085
24. Professional & Other Business Services	0.0139	0.0006	0.0119	0.0022	0.0145	0.0453	0.0081	0.0179	0.0757	0.0023	0.0068
25. Local Government	0.0018	0.0017	0.0018	0.0018	0.0042	0.0018	0.0018	0.0019	0.0018	0.0019	0.0018
26. Households	0.5432	0.314	0.4801	0.0967	0.0727	0.0525	0.116	0.3441	0.2886	0.2174	0.3372
TOTAL	0.9208	0.6493	0.7108	0.5218	0.3262	0.2046	0.2646	0.6486	0.6594	0.34196	0.5983
Imports	0.116	0.3302	0.24	0.2178	0.5747	0.7424	0.704	0.2299	0.2757	0.4843	0.2718
Subsidies	-0.137	-0.074	-0.001	-0.0036	-0.0008	-0.0003	-0.0012	-0.0038	-0.0015	-0.0076	-0.0039
Taxes and Other Value Added	0.1002	0.0945	0.0502	0.2639	0.0998	0.0533	0.0325	0.1253	0.0664	0.1813	0.1338

Table 7.2. (Continued)

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0.0026	0.0181	0	0.0199	0.002	0	0.00007	0	0	0.0076	0	0	0.00002	0.0032	0.0029
0	0	0	0	0	0	0	0	0	0	0	0	0	0.00002	0.002
0.00066	0.0005	0.1616	0.0003	0.0019	0.0127	0.002	0.1465	0.0004	0.0012	0.00006	0	0.00001	0.012	0.0066
0.00005	0.0613	0	0.0001	0.0008	0.0004	0.0	0.00009	0	0	0	0	0.0004	0.0067	0.0306
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0142
0.039	0.011	0.0143	0.0042	0.0122	0.1458	0.005	0.0617	0.0042	0.0159	0.0035	0.0039	0.0077	0.0074	0.0895
0.0024	0.0017	0.0039	0.0127	0	0.009	0.0002	0	0	0.0008	0	0	0.0003	0.0007	0
0.0032	0.002	0.0166	0.002	0.0011	0.003	0.0048	0.0039	0.0038	0.0023	0	0.0044	0.0007	0.0011	0
0.0003	0.0018	0.00007	0.0001	0.0002	0.0225	0.0044	0.0006	0.0002	0.00006	0.00008	0.00002	0.0001	0.044	0.0016
0.00006	0	0.0057	0.0006	0.00005	0.0003	0.0023	0.0034	0.0004	0.0007	0.00004	0.00012	0.00009	0.0002	0.0001
0	0	0	0	0	0	0.0	0	0.002	0	0	0	0.00026	0.0002	0.00002
0.0538	0.0888	0.0075	0.0042	0.0006	0.0104	0.0004	0	0.0012	0.00007	0.0005	0.00004	0.0005	0.0004	0.0054
0.0026	0.002	0.0002	0.00002	0.0	0.00009	0.00004	0.0002	0.0001	0.00001	0.0	0	0.00007	0.00005	0.0012
0.00007	0	0.0072	0.0013	0.0002	0.0005	0.0095	0.0002	0.0024	0.0001	0.00012	0.00002	0.0002	0.0006	0
0.0005	0.00006	0.0014	0.1123	0.0035	0.0017	0.0068	0.0002	0.0008	0.00006	0.0008	0	0.0003	0.001	0
0.0027	0.0068	0.0133	0.0004	0.0165	0.0086	0.0004	0.0018	0.0003	0.0003	0.0013	0.0168	0.0196	0.0014	0.0015
0.001	0.0007	0.0008	0.0145	0.0017	0.0027	0.0015	0.0012	0.0029	0.0006	0.0002	0.0001	0.00035	0.0005	0
0.0055	0.0047	0.0041	0.0044	0.0046	0.0057	0.2385	0.02	0.0369	0.0056	0.0029	0.003	0.0082	0.163	0.0674
0.0428	0.0042	0.0087	0.0067	0.0056	0.0176	0.0004	0.0554	0.0018	0.0014	0.0119	0.0037	0.005	0.0094	0.0383
0.0472	0.0165	0.0257	0.0041	0.025	0.0132	0.0408	0.0055	0.1815	0.0069	0.0023	0.0014	0.0014	0.0697	0.0239
0.002	0.0028	0.0013	0.0044	0.002	0.0026	0.0008	0.0056	0.0068	0.0016	0.0038	0.0091	0.0032	0.006	0.0008
0.0512	0.1027	0.0255	0.0126	0.0426	0.09	0.0752	0.0075	0.0252	0.0118	0.2615	0.0047	0.0083	0.0234	0.0834
0.0122	0.0119	0.002	0.0094	0.0086	0.0093	0.0068	0.0074	0.0309	0.0066	0.004	0.009	0.0057	0.006	0.0076
0.0086	0.0169	0.0085	0.0414	0.0375	0.0263	0.0015	0.0155	0.0063	0.0005	0.0129	0.0366	0.0233	0.1603	0.1202
0.0018	0.0018	0.0008	0.0018	0.0043	0.0019	0.0009	0.0018	0.0074	0.0013	0.0018	0.001	0.0007	0.0018	0.0377
0.3351	0.3829	0.349	0.1106	0.0944	0.2907	0.2848	0.1557	0.214	0.6525	0.1025	0.635	0.7085	0.4446	0
0.6153	0.73916	0.6582	0.368	0.2653	0.675	0.6871	0.4942	0.5296	0.7179	0.41017	0.7289	0.7949	0.9686	0.5349
0.3485	0.1643	0.1911	0.4783	0.542	0.186	0.2835	0.0428	0.299	0.0645	0.5581	0.0794	0.0247	-	0.1355
0.0058	-0.0053	-0.0045	-0.0016	-0.0015	-0.0038	-0.0026	-0.0017	-0.0044	-0.0078	-0.0018	-0.0071	-0.0108	-	
0.0419	0.1018	0.1552	0.1553	0.1942	0.1428	0.032	0.4647	0.1758	0.2254	0.0335	0.1988	0.1912	0.0314	0.3295

"inter-dependence coefficients". The inverse matrix for Tayside shows, for example, when the final demand of the agricultural sector increases by one unit, the output of this sector requires to increase by 1.12327, the output of fishing by 0.00124, etc.

Table 7.3 consists of 25 sectors excluding households as a processing sector. This table indicates only the direct and indirect changes resulting from the change in final demand. However, it is clear that the increase in final demand also gives rise to an increase in the demand for labour which also causes an increase in household incomes. When this happens, households may spend their additional income on purchasing consumer goods[2]. However, this increase in demand for consumables causes an increase in the output of regional processing sectors and these changes, created by the increase in household income, are termed induced effects. In order to quantify these effects, a separate inverse matrix has been derived by including a household row and column in the structural matrix. The matrix given in Table 7.4 presents direct, indirect and induced effects associated with changes in regional final demand.

7.4 GROSS REGIONAL PRODUCTION (GRP) OF TAYSIDE

The Tayside input-output table (Table 7.1) provides the Region's economists, planners and other researchers with a detailed set of regional accounts for the year 1979. These accounts facilitate

[2] The proportion of income spent on consumer goods depends on the income elasticities of different income groups.

Table 7.3. Tayside Survey-Based Input-Output Table: Inverse Matrix No 1

	1	2	3	4	5	6	7	8	9	10	11	12
1. Agriculture	1.12327	0.00124	0.00041	0.09141	0.00118	0.00113	0.00012	0.00038	0.00022	0.00014	0.00020	0.00329
2. Fishing	0.0	1.00014	0.0	0.00389	0.00004	0.00002	0.0	0.0	0.0	0.0	0.0	0.0
3. Quarrying & Oil Exploration	0.01118	0.02481	1.01677	0.00453	0.00206	0.00533	0.01489	0.00515	0.00746	0.00211	0.00406	0.00857
4. Food Products	0.00027	0.00989	0.00016	0.08065	0.01068	0.00421	0.00021	0.00014	0.00011	0.0001	0.00013	0.00047
5. Brewing, Soft Drinks & Spirits	0.00001	0.00021	0.0	0.02342	1.05242	0.00009	0.0	0.0	0.0	0.0	0.0	0.00001
6. Oil Products & Chemicals	0.05844	0.01702	0.02948	0.01650	0.01207	1.04155	0.03276	0.02090	0.00762	0.01947	0.02049	0.04787
7. Metal & Metal Oroducts	0.00116	0.00878	0.01857	0.00685	0.01188	0.00533	1.00153	1.00435	0.02399	0.00323	0.08741	0.00303
8. Mechanical Engineering	0.03730	0.00363	0.00503	0.00433	0.00517	0.00278	0.00409	1.00388	0.00682	0.00733	0.02251	0.00430
9. Instrument Engineering	0.00229	0.00081	0.00093	0.00061	0.00116	0.00047	0.00052	0.04976	1.01644	0.00684	0.00188	0.00083
10. Electrical Engineering	0.00065	0.03469	0.00063	0.00029	0.00044	0.00016	0.00073	0.00242	0.00098	1.01173	0.00299	0.00033
11. Ship Building	0.00012	0.07640	0.00026	0.00035	0.00019	0.00017	0.00009	0.00041	0.00028	0.00007	1.10601	0.00019
12. Textiles	0.00047	0.07319	0.00036	0.00068	0.00027	0.00022	0.00058	0.00203	0.00023	0.00035	0.00030	1.05720
13. Clothing	0.00002	0.00092	0.00004	0.00012	0.00004	0.00005	0.00001	0.00012	0.00002	0.00001	0.00023	0.0027[illegible]
14. Building Materials	0.00106	0.00048	0.00816	0.00035	0.00132	0.00081	0.00590	0.00135	0.00100	0.00154	0.00134	0.000[illegible]
15. Timber Products	0.00151	0.00259	0.01470	0.00202	0.00906	0.00164	0.00208	0.00604	0.00099	0.00334	0.00632	0.00109
16. Paper, Printing & Publishing	0.00307	0.00225	0.00127	0.01422	0.00633	0.00604	0.00141	0.01058	0.01248	0.00082	0.00224	0.00404
17. Rubber & Plastic Products	0.00057	0.00345	0.00149	0.00238	0.00293	0.00318	0.00078	0.00270	0.0013[illegible]	0.00196	0.00088	0.001[illegible]
18. Construction	0.05092	0.00488	0.03495	0.01178	0.08077	0.00623	0.01507	0.01462	0.00968	0.00929	0.00784	0.01394
19. Utilities	0.01832	0.00749	0.03434	0.00941	0.00899	0.02319	0.00701	0.01791	0.04616	0.00719	0.01441	0.05076
20. Transport	0.01753	0.02780	0.07868	0.00854	0.04308	0.01171	0.02235	0.01780	0.01533	0.02143	0.00871	0.06405
21. Communication	0.00759	0.01053	0.00328	0.00431	0.00350	0.00138	0.00202	0.02015	0.01617	0.00409	0.00211	0.00356
22. Distribution	0.13438	0.07612	0.02368	0.31562	0.07516	0.01242	0.07353	0.17720	0.17345	0.05938	0.02262	0.08069
23. Finance Services	0.03383	0.04546	0.02075	0.00658	0.00681	0.01072	0.00278	0.02603	0.05255	0.00204	0.01110	0.01684
24. Professional, Business & Other Services	0.02390	0.00697	0.01752	0.01094	0.01989	0.05030	0.01207	0.02829	0.08567	0.00576	0.01180	0.01555
25. Local Government	0.00276	0.00261	0.00273	0.00303	0.00513	0.00215	0.00226	0.00270	0.00263	0.00231	0.00243	0.00282

Table 7.3. (Continued)

13	14	15	16	17	18	19	20	21	22	23	24	25
0.02637	0.00022	0.02529	0.00252	0.00037	0.00039	0.00024	0.00018	0.00858	0.00010	0.00014	0.00017	0.00443
0.00024	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00005
0.00297	0.16742	0.00279	0.00336	0.01743	0.00544	0.15835	0.00201	0.00177	0.00280	0.00080	0.00109	0.01557
0.06651	0.00014	0.00022	0.0010	0.00112	0.00006	0.00045	0.00012	0.00008	0.00006	0.00006	0.00051	0.00741
0.00144	0.0	0.0	0.00002	0.00002	0.0	0.00001	0.0	0.0	0.0	0.0	0.00001	0.00016
0.01960	0.02227	0.01093	0.01491	0.15626	0.00908	0.07362	0.00754	0.01760	0.00662	0.00533	0.00931	0.01340
0.00261	0.00724	0.01468	0.00027	0.01078	0.00081	0.00334	0.00045	0.00096	0.00013	0.00010	0.00064	0.00243
0.00366	0.01801	0.00351	0.00158	0.00407	0.00706	0.00541	0.00539	0.00278	0.00022	0.00461	0.00098	0.00345
0.00229	0.00126	0.00084	0.00062	0.02339	0.00644	0.00133	0.00144	0.00033	0.00025	0.00024	0.00027	0.04612
0.00014	0.00604	0.0008	0.00014	0.00050	0.00322	0.00385	0.00072	0.00076	0.00014	0.00018	0.00015	0.000[illegible]2
0.00015	0.00016	0.00017	0.00020	0.00017	0.00017	0.00013	0.00275	0.00003	0.00007	0.00012	0.00295	0.00094
0.09427	0.00821	0.00528	0.00080	0.01123	0.00092	0.00017	0.00172	0.00012	0.00075	0.00013	0.0006	0.00086
1.00227	0.00024	0.00005	0.00001	0.00014	0.00007	0.00023	0.00013	0.00001	0.00001	0.00001	0.00008	0.00009
0.00029	1.00884	0.00174	0.00045	0.00102	0.01288	0.00186	0.00361	0.00025	0.00028	0.00011	0.00036	0.00321
0.00064	0.00436	1.12680	0.00429	0.00274	0.01046	0.00294	0.00175	0.00024	0.00135	0.00019	0.00059	0.00339
0.00922	0.01452	0.00207	1.01806	0.01109	0.00148	0.00316	0.00161	0.00065	0.00237	0.01814	0.02067	0.00605
0.00119	0.00136	0.01653	0.00201	1.00345	0.00244	0.00183	0.00377	0.00072	0.00038	0.00021	0.00048	0.00142
0.01191	0.01425	0.01003	0.01009	0.01243	1.31820	0.03501	0.06236	0.00888	0.00684	0.00525	0.01193	0.22231
0.01247	0.01681	0.01009	0.00784	0.02633	0.00361	1.06610	0.00393	0.00243	0.01757	0.00465	0.00614	0.01518
0.02856	0.04693	0.00828	0.03294	0.02212	0.06770	0.02216	1.22688	0.00962	0.00500	0.00305	0.00346	0.09965
0.00459	0.00282	0.00579	0.00292	0.00433	0.00254	0.00696	0.00924	1.00197	0.00547	0.00956	0.00356	0.00876
0.17216	0.04643	0.02867	0.06318	0.13373	0.14055	0.02053	0.05127	0.01925	1.35604	0.00974	0.0149	0.07217
0.01648	0.00776	0.01275	0.01094	0.01444	0.01265	0.01275	0.03952	0.00767	0.00615	1.00993	0.00659	0.01514
0.02411	0.01501	0.05099	0.04258	0.04048	0.00702	0.02421	0.01267	0.00252	0.01942	0.03936	1.02595	0.17242
0.00285	0.00180	0.00239	0.00487	0.00288	0.00207	0.00266	0.00937	0.00150	0.00258	0.00121	0.00093	1.00325

Table 7.4. Tayside Survey-Based Input-Output Tables: Inverse Matrix No 2

		1	2	3	4	5	6	7	8	9	10	11	12
1.	Agriculture	1.12916	0.00494	0.00505	0.09323	0.00243	0.00208	0.00144	0.00407	0.00386	0.00222	0.0037	0.00681
2.	Fishing	0.00193	1.00135	0.00152	0.00449	0.00045	0.00033	0.00043	0.00121	0.0012	0.00068	0.00115	0.00115
3.	Quarrying & Oil Exploration	0.02475	0.03336	1.02749	0.00873	0.00493	0.00753	0.01794	0.01368	0.01587	0.00691	0.01212	0.01668
4.	Food Products	0.03122	0.02937	0.02459	1.09022	0.01722	0.00923	0.00716	0.01959	0.01928	0.01104	0.0185	0.01897
5.	Brewing, Soft Drinks & Spirits	0.01425	0.00918	0.01125	0.02783	1.05543	0.0024	0.0032	0.00896	0.00883	0.00504	0.0096	0.00852
6.	Oil Products & Chemicals	0.014968	0.07447	0.10152	0.04472	0.03137	1.0563	0.05324	0.07825	0.06415	0.05174	0.0747	0.10242
7.	Metal & Metal Products	0.00246	0.00960	0.0196	0.00725	0.01215	0.00555	1.00182	0.00517	0.0248	0.00369	0.08819	0.0038
8.	Mechanical Engineering	0.03890	0.00464	0.00629	0.00482	0.00551	0.00304	0.0044	1.00488	0.00781	0.0079	0.02346	0.00525
9.	Instrument Engineering	0.00596	0.00312	0.00389	0.00174	0.00194	0.00106	0.00134	0.05207	1.01872	0.00814	0.00406	0.00302
10.	Electrical Engineering	0.00124	0.03507	0.0011	0.00048	0.00057	0.00026	0.00087	0.0028	0.00135	1.01194	0.00335	0.00069
11.	Ship Building	0.00074	0.07680	0.00075	0.00054	0.00033	0.00027	0.00023	0.0008	0.00067	0.00029	1.10638	0.00056
12.	Textiles	0.00619	0.07679	0.00488	0.00245	0.00148	0.00115	0.00187	0.00563	0.00377	0.00237	0.0037	1.06072
13.	Clothing	0.00116	0.00164	0.00095	0.00047	0.00028	0.00024	0.00027	0.00083	0.00073	0.00041	0.00091	0.00346
14.	Building Materials	0.00232	0.00127	0.00915	0.00074	0.00159	0.00102	0.00618	0.00214	0.00178	0.00198	0.00208	0.00126
15.	Timber	0.00299	0.00352	0.01587	0.00248	0.00937	0.00188	0.00242	0.00697	0.00191	0.00387	0.0072	0.00198
16.	Paper, Printing & Publishing	0.0085	0.00567	0.00556	0.0159	0.00748	0.00692	0.00263	0.014	0.01584	0.00274	0.00546	0.00729
17.	Rubber & Plastic Products	0.00139	0.00397	0.00213	0.00263	0.00311	0.00331	0.00096	0.00322	0.00182	0.00225	0.00137	0.00203
18.	Construction	0.14604	0.06477	0.11005	0.04119	0.10089	0.02165	0.03642	0.07441	0.06862	0.04292	0.06434	0.07081
19.	Utilities	0.06114	0.03445	0.06815	0.02265	0.01805	0.03013	0.01662	0.4482	0.07269	0.02233	0.03984	0.07636
20.	Transport	0.05600	0.05202	0.10905	0.02044	0.05122	0.01795	0.03099	0.04198	0.03917	0.03504	0.03156	0.08705
21.	Communication	0.01047	0.01235	0.00555	0.0052	0.00411	0.00185	0.00267	0.02196	0.01795	0.00511	0.00382	0.00529
22.	Distribution	0.26403	0.15775	0.12604	0.35571	0.10258	0.03343	0.10264	0.2587	0.25377	0.10523	0.09962	0.1582
23.	Finance Services	0.04622	0.05326	0.03053	0.01041	0 00943	0.01273	0.00556	0.03381	0.06023	0.00642	0.01846	0.02425
24.	Professional, Business & Other Services	0.15022	0.08651	0.11725	0.0500	0.04661	0.07078	0.04043	0.1077	0.16393	0.05043	0.08683	0.09107
25.	Local Government	0.03823	0.0249	0.03073	0.01400	0.01263	0.0079	0.01022	0.02499	0.0246	0.01485	0.0235	0.02402
26.	Households	0.90831	0.57192	0.71713	0.28087	0.1921	0.14725	0.20389	0.57097	0.56275	0.32118	0.53949	0.54302

Table 7.4. (Continued)

13	14	15	16	17	18	19	20	21	22	23	24	25	26
0.03052	0.00424	0.02702	0.00385	0.0036	0.00398	0.00271	0.00298	0.01416	0.00151	0.00578	0.00632	0.01027	0.00825
0.0016	0.00132	0.00057	0.00044	0.00106	0.00118	0.00081	0.00092	0.00183	0.00046	0.00185	0.00202	0.00196	0.00271
0.01255	0.17670	0.00677	0.00643	0.02489	0.01374	0.16405	0.00845	0.01465	0.00604	0.01383	0.01529	0.02904	0.01904
0.08836	0.02129	0.0093	0.00799	0.01812	0.01897	0.0134	0.01481	0.02944	0.00743	0.02976	0.03287	0.03812	0.0434
0.01149	0.00974	0.00418	0.00324	0.00785	0.0087	0.00599	0.00677	0.01351	0.0034	0.01367	0.0149	0.01429	0.01997
0.08401	0.08462	0.03771	0.03553	0.20638	0.06484	0.11192	0.05087	0.10414	0.02836	0.09288	0.10472	0.10325	0.12796
0.00352	0.00813	0.01506	0.00057	0.0115	0.00161	0.00388	0.00106	0.00219	0.00044	0.00135	0.002	0.00372	0.00183
0.00479	0.0191	0.00398	0.00194	0.00495	0.00803	0.00608	0.00615	0.0043	0.00061	0.00615	0.00265	0.00504	0.00224
0.00488	0.00377	0.00192	0.00145	0.0254	0.00869	0.00287	0.00318	0.00382	0.00113	0.00387	0.00411	0.04976	0.00515
0.00056	0.00644	0.00098	0.00027	0.00083	0.00359	0.0041	0.0010	0.00133	0.00029	0.00075	0.00079	0.00151	0.00084
0.00059	0.00059	0.00035	0.00034	0.00051	0.00055	0.00039	0.00305	0.00062	0.00022	0.00072	0.00361	0.00156	0.00088
0.09831	0.01212	0.00696	0.00209	0.01437	0.00441	0.00257	0.00444	0.00555	0.00212	0.00559	0.00657	0.00653	0.00802
1.00307	0.00102	0.00038	0.00027	0.00077	0.00077	0.00071	0.00068	0.0011	0.00028	0.00110	0.00127	0.00122	0.0016
0.00117	1.00969	0.00211	0.00073	0.00171	0.01364	0.00238	0.00421	0.00144	0.00058	0.00131	0.00167	0.00445	0.00176
0.00169	0.00537	1.12723	0.00462	0.00356	0.01137	0.00356	0.00246	0.00165	0.00171	0.00161	0.00214	0.00486	0.00208
0.01305	0.01823	0.00366	1.01929	0.01407	0.00479	0.00544	0.00418	0.0058	0.00366	0.02334	0.02635	0.01143	0.00761
0.00177	0.00192	0.01677	0.00219	1.0039	0.00294	0.00218	0.00416	0.0015	0.00057	0.00099	0.00134	0.00223	0.00115
0.07905	0.07925	0.03794	0.03158	0.06468	1.37633	0.07494	0.10753	0.09909	0.02951	0.09653	0.11139	0.31771	0.13339
0.0427	0.04607	0.02266	0.01751	0.04985	0.02978	1.08407	0.02427	0.04304	0.02778	0.04574	0.05091	0.05767	0.06005
0.05572	0.07322	0.01957	0.04163	0.0432	0.09121	0.03833	1.24495	0.04611	0.01417	0.03997	0.04369	0.13783	0.05395
0.00662	0.00479	0.00663	0.00357	0.00591	0.00431	0.00817	0.01061	1.0047	0.00615	0.01233	0.00658	0.01162	0.00404
0.26368	0.13502	0.06672	0.09247	0.20495	0.21978	0.07495	0.11284	0.1422	1.38694	0.13415	0.15047	0.20083	0.18182
0.02523	0.01622	0.01639	0.01373	0.02124	0.02021	0.01795	0.0454	0.01942	0.0091	1.02181	0.01955	0.02744	0.01737
0.11328	0.10133	0.08806	0.07113	0.10987	0.08421	0.07724	0.07266	0.12232	0.04953	0.16058	1.15804	0.29779	0.17715
0.02786	0.02603	0.01280	0.01288	0.02237	0.02375	0.01755	0.02621	0.03513	0.01103	0.03524	0.03801	1.03846	0.04974
0.64115	0.62072	0.26657	0.20522	0.49896	0.5550	0.38127	0.43132	0.86143	0.21647	0.87157	0.94977	0.90141	1.27380

the derivations of a set of macro-economic indicators, such as gross Regional production, the Regional household income and the Regional balance of trade.

The Tayside GRP can be defined as the value of goods and services produced in the Region. It can be calculated in two ways, ie, from the expenditure and the factor income sides of the input-output table. The computations of GRP from the expenditure side needs household consumption, central and local government expenditures, capital formation by regional industries, and net export figures. In contrast, calculations of GRP from the factor income side needs wages and salaries, profits, other value added and depreciation figures. In the Tayside study, GRP was calculated from the expenditure side due to a lack of disaggregation of primary inputs, in particular, in taxes and other value added.

Table 7.5 presents the GRP for the Tayside economy. As shown in this table, the GRP for Tayside was £2866 per head at market prices in 1979. When this figure is compared with the GRP for 1977, which was £2115 per head[3], it indicates an increase of 35% in Tayside gross regional production[4]. In 1979 the GRP at market prices in the UK was £3460 per head[5]. The gross Scottish product at market prices is not available for 1979. Hence the Tayside GRP can be compared with the UK figure and it shows a difference of £504. This difference is partly attributable to variations in labour productivity in industries, to the differences in the distribution

---

[3] Central Statistical Office, Regional Trends 1982, p47.

[4] It should be noted that the method of computation of GRP, ie at market prices or factor cost for Tayside in 1977, is not given in Regional Trends.

[5] HMSO, Annual Abstract of Statistics 1983, p.264,

Table 7.5

Tayside Gross Regional Production for 1979

	£
Household expenditure	536,583,000
(i) Purchase from local processors	425,307,000
(ii) Purchase from non-local industries	108,276,000
Private investment (Fixed capital formation and stock appreciation)	272,059,000
Government expenditure (net of intra and inter governmental transfers, government debts, interests and imports)	1,88,661,000
Net exports (Exports minus imports)	146,270,000
GRP at market prices	1,143,573,000
GRP per head	2,886

of population in terms of age and partly to variations in trade balance, government expenditure, fixed capital formation, etc, between Tayside and the UK. For example, because Tayside has been given Special Development Area Status some of its industries receive a higher amount of government subsidies and other financial benefits than the national average.

Table 7.6

GRP of Tayside: Sectoral Contribution

Industrial Sector	%	Industrial Sector	%
Agriculture	1.6	Textiles	2.64
Fishing	0.1	Clothing	0.34
Quarrying & Oil	2.06	Timber Products	2.59
Food Products	12.13	Paper, Printing, ...	10.25
Brewing	4.42	Rubber Products	0.21
Oil Products & Chemicals	14.04	Distribution	11.76
Metal Products	2.27		
Engineering	14.5		
Shipbuilding	0.64		

Table 7.6 presents sectoral contributions to the GRP of Tayside and it shows that food products, oil products and chemicals, printing and publishing, and distribution were together the largest value creating industrial sectors in Tayside in 1979, contributing 48% to the regional production. Mechanical, instrument, and electrical engineering contributed 14.5% to regional income. The industries such as shipbuilding, textiles and metal products generated only 5.5% while the primary sectors contributed 1.7.% to the regional income.

One of the striking features of service sectors, except distribution, according to the input-output accounts in the Tayside Region in 1979, was that they have not recorded a considerable amount of exports; but they have imported goods and services. This has resulted in the creation of negative impacts upon the regional GRP. This is because when the GRP is estimated from the expenditure side, the exports and imports play the main role and in service sectors, except imports, other variables such as government expenditure, stock appreciation, and fixed capital formation represent small values. However, this may not be the case when the income approach is used to estimate the GRP.

The main factors of the income side are household incomes and the value added finally created by the processing sectors. The household income generated by the intermediate sectors in terms of wages and salaries amounted to £714 million and it indicates an income of £4409 per employee per annum. So the average weekly earnings in 1979, as revealed by the present Tayside input-output study, were £85 per employee. The equivalent figures for the UK and Scotland in 1979 were £96.60 and £95.40 respectively. Thus one of the main features of the Tayside economy is the lower wage earnings compared to Scotland and the UK.

The total personal incomes received from wages and salaries and from other sources amounted to £800 million in 1979 and this gives a per capita weekly income of £38.50. This level of income is considerably lower when compared with the equivalent figures of £58 and £56 for the UK and Scotland respectively. This is partly because of the low weekly earnings when compared to the UK and it may also be partly because of the use of more capital intensive techniques in production. On the other hand, one of the main features of Tayside economy is the existence of foreign owned manufacturing companies. Some sectors such as instrument engineering are largely dominated by companies from outside the region. Although there is not enough statistical evidence available, there may be a large proportion of profits, dividends, etc, repatriated outside the region. This outflow of income generated in the region may also be one of the reasons for lower personal incomes in Tayside.

Table 7.7 indicates the incomes contributed by the main industrial sectors in Tayside. This shows that the largest contributions to the household incomes were made by professional and other business services. The engineering sectors contributed 9% and construction generated 9.5% of household income. Apart from the manufacturing and service sectors the other main income generator in the Region in 1979 was local government. This created 6% of total household income of Tayside.

The Tayside domestic flow matrix shows that a larger proportion of the total sales by the processing sectors goes to final demand. Table 7.8 shows the distribution of gross outputs to the final demand sectors. It reveals that some sectors such as clothing, metal and metal products, paper, printing and publishing, etc, sold more than 80% of their gross outputs to final demand sectors leaving less than 20% for the regional processing sectors. This reflects one of the region's major characteristics, as was pointed out in chapter 3, i.e., the openness of the region to foreign trade.

Table 7.7

TAYSIDE HOUSEHOLD INCOMES BY SECTOR

Sector	%
Agriculture	3.08
Engineering Sectors	9.09
Textiles	4.03
Construction	9.46
Distribution	10.00
Professional and other business services	21.30
Local Government	6.10

7.5 TRADE

Table 7.1 shows that in 1979 the total exports income of the Tayside Region was £1478.6 million while expenditure on imports amounted to £1332.3 million. These two figures can be used to obtain a crude measure of regional trade. It shows that Tayside had a favourable balance of trade of £146.3 million in 1979. This accounted for 12.8% of the gross regional product in Tayside. The value of exports was 38% of the total gross outputs and the expenditure on imports accounted to 34% of the total value of inputs. Table 7.8 presents the total expenditure on imports and exports as percentages of gross inputs and gross outputs respectively. According to these statistics, Tayside has a high level of exports and imports which reflected the high level of trade relationships outside the Region.

The Region's industrial sectors can be ranked according to their expenditure on imports. It can be seen that oil products and chemicals, metal and metal products, brewing and other spirits, paper, printing and publishing, and distributors spent over 50% of their gross outputs[6] on imports. Also oil products and chemicals and metal and metal products relied heavily on imports which accounted for over 70% of their sectoral gross outputs. This suggests that there is a high level of leakages from the Tayside economy and also low level of inter-industrial dependence in the region.

One of the main characteristics of the Tayside economy revealed by the input-output accounts is the high level of exports income out of the total gross outputs. The ranking of industrial sectors according to their level of export income is shown in table 7.8. It reveals that engineering, textile, clothing, and printing and publishing exported over 80% of their gross outputs in 1979. The primary sectors and services contributed less to exports than the manufacturing sectors. The analysis of exports of the region as a whole[7] reflects that the distributors were the largest export income earners in the region. The manufacturing sectors earned 68% of the total export income. This means, though the manufacturing sectors accounted for a high level of expenditure on imports, its export earnings were considerably higher than those of the primary and service sectors.

---

[6] Total gross outputs $\equiv$ total gross inputs.

[7] see column 9 in table 7.8.

Table 7.8

DISTRIBUTION OF EXPORTS AND IMPORTS OF THE TAYSIDE REGION IN 1979

Sectors	Imports				Exports			
	1		2		3		4	
		5		6		7		8
1. Agriculture	11.6	20	0.4	15	33.5	16	1.03	15
2. Fishing	33	9	0.06	20	14.4	19	0.02	19
3. Quarrying & Oil Exploration	24	14	0.9	13	56.4	12	2	13
4. Food Products	22	16	3.1	8	76.2	8	9.8	3
5. Brewing, Soft Drinks & Other Spirits	57	3	5.9	5	67.6	11	6.3	7
6. Oil Products & Chemicals	74	1	13.4	2	47	13	7.7	4
7. Metal & Metal Products	70.4	2	6.4	4	88	2	7.3	5
8. Mech. Engineering	23	15	1.4	12	84	5	4.5	9
9. Instr. Engineering	27.5	12	2.5	9	80	7	6.5	6
10. Elec. Engineering	48.4	6	1.8	11	88.8	1	3	11
11. Shipbuilding & Marine Engineering	27.1	13	0.5	14	88	2	1.4	14
12. Textiles	35	8	2.5	9	82	6	5.3	8
13. Clothing	16	19	0.2	17	87	3	0.9	17
14. Building Materials	19	17	0.13	18	42.2	15	0.3	18
15. Timber Products	48	7	2.4	10	68	10	3.04	10
16. Paper, Printing & Publishing	54	5	7.03	3	85	4	10	2
17. Rubber & Plastic Products	18.6	18	0.3	16	70.5	9	1	16
18. Construction	28.3	11	5.6	6	5.2	20	0.9	17
19. Utilities	4.3	22	0.2	17	-	-	-	-
20. Transport	30	10	3.5	7	2.2	17	2.4	12
21. Communications	6.4	23	0.1	19	-	-	-	-
22. Distribution	56	4	32.6	1	43	14	22.7	1
23. Finance Services	7.9	21	0.2	17	-	-	-	-
24. Professional, Business & Other Services	2.5	24	0.4	15	15	18	2.4	12
25. Local Government	-	-	-	-	-	-	-	-

1 Imports as a % of sectoral gross inputs

2 Imports as a % of total regional imports

3 Exports as a % of sectoral gross outputs

4 Exports as a % of total regional exports

5, 6, 7, and 8 are rankings of sectors, according to 1, 2, 3 and 4

7.6 INTER-INDUSTRIAL DEPENDENCE

The degree of inter-dependence on the input side revealed by the Tayside Regional input-output accounts is not significant particularly when the household sector is excluded from the structural matrix. The proportion of Regional inter-industrial transactions as a percentage of the value of total inputs is 33%. When the household sector is included it amounts to 51%. This suggests a low level of inter-industry relationships and a high level of regional dependency on imports. It may be seen also that the total intermediate outputs in the region in 1979 were nearly 51% of the total gross outputs, leaving nearly 49% for final demand sectors.

The direct intra-regional industrial dependence can also be crudely measured by the amount of blank cells appearing in each industry, both along its row and down the column within the structural matrix. The blank cells indicate the non-existence of trade relationships either in terms of buying or selling goods between the particular industrial sectors concerned. The high number of blank cells for a sector illustrates a low level of inter-industrial dependence and vice-versa. It is found that nearly 15% of the total cells (26 x 26) are blank and also that almost all the blank cells in the Tayside input-output table appear in the upper part of the structural matrix. This shows that Tayside industries buy more direct inputs from outside the region and buy indirect inputs such as distribution, professional finance and other services from the region. It may be seen also from table 7.8 that the manufacturing sectors, except building materials, and oil products and chemicals sold over 75% of their outputs to the final demand sectors. This implies a low level of marketing relationships among the regional producers.

In analysing supply relationships in Tayside, one can examine the inputs that the local producers buy from the region's industries. The Tayside domestic flow coefficients table shows that some industries such as agriculture, food products, clothing and building materials, purchase over 80% of their total inputs from the local producers. Reading across the imports row illustrates the dependence of Tayside producers on producers outside the region. As discussed in section 7.5 and presented in table 7.8, the quite high degree of dependence of local industries on imports suggests opportunities for the substitution of locally produced goods, particularly if these imports have competitive producers in Tayside. Also some competitive imported goods can be produced locally at higher cost. Therefore, the comparative advantages in trade need to be analysed in justifying the supply relationships of the Tayside Region with local producers and outsiders.

7.7 MULTIPLIER ANALYSIS

Inter-industry relationships may be measured using the base multiplier approach and linear programming models. However, the main difficulty which arises in using these techniques at the operational level is the resources required to estimate intra-regional industrial relationships.

Relationships between the initial spending and the total effects generated by this spending are regarded as multiplier effects. Keynes described the multiplier as follows: "A unit increment of autonomous investment causes an initial increase in income which generates successive rounds of consumer spending and incomes, each round producing numerically smaller increments until the process has fully worked itself out, i.e, has reached equilibrium"[8]. There are some significant differences between Keynesian national multipliers and regional sectoral multipliers. It is clear that there are many leakages from and into regional economies. Inter-regional imports, for example, are a major source of such leakage. The national multipliers cannot take these additional leakages into account. Also these leakages vary from region to region and they depend on the size of the regions and the nature of regional industrial structures. The national multipliers cannot be used for the estimation of sectoral multipliers.

The Tayside input-output tables facilitate the derivations of a set of multipliers which take the leakages of the Tayside economy into account. Leontief stated that "the input-output table is not merely a device for displaying or storing information, it is above all an analytical tool"[9]. The inverse matrix, which is the analytical tool that Leontief suggested, is used here to measure the sectoral multipliers for Tayside.

---

[8] Keynes, J M, The General Theory of Employment Interest and Money, New York, Brace & Co, 1935, pp.113-131.

[9] Leontief, W, "The Structure of Development", Scientific American, Vol 209, No 3, 1963, p.149.

Multiplier effects can be disaggregated into direct, indirect and induced effects. The direct and indirect effects measure the changes in output, income or employment resulting from changes in final demand. In order to quantify these effects, the household sector is excluded from the structural matrix. The resulting multipliers are known as type one multipliers. It is also clear that the increase in final demand results in changes in household incomes. These changes in household income also create direct and indirect effects on all other sectors in the economy. The total effects, i.e, direct, indirect and induced, created by the changes in final demand are quantified in inverse matrix, No 2 (Table 7.4) and the results are known as type two multipliers.

The Tayside economic structure can be analysed by estimating multipliers in three ways, namely output multipliers, income multipliers, and employment multipliers. The output multipliers measure effects of changes in final demand in a particular sector upon the level of gross output of the sector concerned. The income multipliers quantify the effects of increasing final demand upon the regional household income. The changes in final demand are normally associated with changes in gross outputs. When the gross output of a sector is subject to change it also affects its workforce. It may be seen that the size of the workforce is increasing when the demand for output increases. The effects of changes in final demand upon the number of employees are measured by the employment multipliers. The main assumption of multiplier analysis is that the pattern of purchase of the inputs to a sector remains unchanged even if the level of output of that sector is subject to change.

7.7.1 OUTPUT MULTIPLIERS

The output multipliers for Tayside are given in table 7.9. The type one output multipliers presented in column one measure the direct and indirect effects upon the gross outputs of sectors resulting from the change of final demands by £1. The ranking of the sectors according to the type one multipliers shows that the direct and indirect increase of gross output generated by an increase of £1 in final demand is highest in local government. It reveals that the increase of final demand of local government results in an increase in its output by 1.719 times. Apart from this, table 7.9 shows relatively higher type one output multipliers for food products, construction, agriculture, and clothing than other sectors.

These multipliers can be compared with the regional imports given in table 7.8. It shows that local government has the lowest amount of imports. This implies that the type one output multipliers are high for the sectors which have a low level of leakages. When leakages from the economy are high, the type one output multipliers tend to give low values. This means that when spending on imports is high, any increase in outputs associated with changes in final demand results in increases in the demand for goods produced outside the region. Table 7.8 also shows that the import of goods for agriculture, clothing, and for construction are relatively low and this has resulted in high values for the type one output multipliers.

Table 7.9

THE TAYSIDE REGION OUTPUT MULTIPLIERS

	Type 1 Multipliers	Type 2 Multipliers	Rank Type 1	Rank Type 2
	1	2	3	4
1. Agriculture	1.53062	3.10351	4	2
2. Fishing	1.44234	2.43271	10	11
3. Quarrying & Oil Exploration	1.31421	2.55605	18	8
4. Food Products	1.62281	2.10917	2	17
5. Brewing, Soft Drinks & Spirits	1.36059	1.69324	15	22
6. Oil Products & Chemicals	1.19129	1.44628	21	25
7. Metal & Metal Products	1.2028	1.55587	20	24
8. Mech. Engineering	1.41489	2.40362	12	12
9. Instr. Engineering	1.4816	2.45608	7	10
10. Elec. Engineering	1.17054	1.72672	22	21
11. Shipbuilding & Marine Engineering	1.33805	2.27226	17	15
12. Textiles	1.38435	2.32467	14	14
13. Clothing	1.50699	2.61725	5	5
14. Building Materials	1.41208	2.48696	13	9
15. Timber Products	1.34068	1.80229	16	20
16. Paper, Printing & Publishing	1.2256	1.58098	19	23
17. Rubber & Plastic Products	1.50051	2.36454	6	13
18. Construction	1.61527	2.57644	3	7
19. Utilities	1.44731	2.10754	9	18
20. Transport	1.44824	2.19515	8	16
21. Communications	1.08875	2.58045	25	6
22. Distribution	1.43462	1.80948	11	19
23. Finance Services	1.11319	2.62247	23	4
24. Professional, Business & Other Services	1.11235	2.75703	24	3
25. Local Government	1.71978	3.28072	1	1

The sectors which have high values for type one output multipliers also depend more on regional industries. For example, when the final demand of local government increases by £1 it results in an increase in the outputs of all the other intermediate sectors by 1.003 of local government itself, by 0.17 of professional and other business services, etc.

Type two output multipliers quantify the direct, indirect and induced effects upon the sectoral output, resulting from changes in final demand by £1. When the induced effects are taken into account, output multipliers for every sector produce higher values than type one multipliers would indicate. However, increases in type two multipliers vary from sector to sector. Local government and agriculture produce the highest type two output multipliers. The ranking of the sectors according to type two, shows significant changes for some sectors, especially professional and other services, finance and communication when compared to the type one multipliers.

Apart from the regional leakages and the level of inter-industrial dependence, one other major factor which affected type two multipliers can be highlighted by comparing the fourth column of table 7.9 and the first column of table 7.14. The figures in these two columns suggest that local government, agriculture, finance, and professional and business services generate higher levels of type two multipliers and also higher employment/output ratios than other sectors. This suggests that the variables, i.e, type two output multipliers and the employment/output ratios are positively correlated. This also indicates that the type two multipliers are affected by differences in sectoral production techniques. The

Tayside manufacturing sectors use more capital intensive techniques and have lower employment/output ratios, than the primary and service sectors. This point is clearly visible in the type two multipliers for manufacturing, and almost every sector in manufacturing produces lower values for type two multipliers. Local government, communications, professional and finance services show high values for type two which may be partly due to the use of more labour intensive techniques.

The sectors which are less capital intensive generally create greater level of household incomes. This means when the final demand increases, say in agriculture, then payments for labour are also increasing. The increase in household income results in an increase in the demand for consumer products which effects an increase in the outputs of these later sectors. In this way one £1 increase in the final demand of agriculture results in an increase in its output by 3.1 times.

The Tayside output multipliers can be compared with those of other regions to highlight some characteristics of Tayside more clearly. Table 7.10 presents output multipliers, types one and two, for Shetland and Tayside. The figures show that the Tayside type one multipliers are greater than those of Shetland except for three sectors, i.e, professional, local government and communications. The larger values for output multipliers in Tayside indicate a greater degree of dependence on regional industries, and a relatively lower level of leakages. The higher values for type two multipliers for Tayside also indicate a higher level of household earnings than in Shetland. In relation only to the selected sectors in table 7.10,

Table 7.10

COMPARISONS OF TYPE ONE AND TYPE TWO OUTPUT MULTIPLIERS

	Tayside		Shetland	
	Type 1	Type 2	Type 1*	Type 2*
Agriculture	1.53	3.10	1.33	2.35
Fishing	1.44	2.43	1.24	2.25
Textiles	1.384	2.32	1.08	1.88
Construction	1.615	2.576	1.1	1.58
Professional	1.11	2.62	1.2	2.39
Local Government	1.719	3.28	1.93	2.9
Communications	1.08	2.58	1.18	2.72

* source: McNicoll, I H, The Shetland Economy, Research Monograph, No 2, The Fraser of Allander Institute, 1976.

it may be suggested that the primary and service sectors in Tayside are more labour intensive than those in Shetland. However, it should be noted that the times of the construction of these two tables, the size of the regions, and also the patterns of sector classification are very different between the two regions. These factors can have a significant influence in the determination of the level of multipliers.

7.7.2 INCOME MULTIPLIERS

In this section two types of sectoral income multipliers are discussed, namely type one and type two. The type one income multipliers are the ratio of direct and indirect changes of income to direct income change resulting from an increase in final demand. The type two multipliers are defined as the ratios of direct, indirect and induced income changes to the direct income changes created by changes in final demand[10]. These multipliers are used to analyse secondary and induced household income generated by the increase in final demand in the Tayside input-output table.

The computation of income multipliers is based on the concept of the consumption function. It is necessary to estimate average and marginal propensities to consume, in order to measure the income multipliers accurately. The application of national consumption functions to Tayside is not practicable because of regional leakages caused mainly by imports of consumer goods. Peterson attempted to quantify the multipliers using national data, but he showed that they were not successful[11]. Thus it is important to estimate consumption function for each sector of the Tayside input-output table separately. In practice, however, the estimation of consumption functions for each sector is not easy. Miernyk (1967) for example, attempted to establish consumption functions for each sector in the Boulder economy[12]. His estimations have yielded

---

[10] For a discussion on multipliers see Werner, Z, Hersch, "Inter-Industry Relations of a Metropolitan Area", The Review of Economics and Statistics, XLI, 4, pp.360-369, and

Moore, F.T, "Regional Economic Reaction Paths", American Economic Review, XLV, 2, 1955, pp. 133-148.

[11] Moore, F.T and Peterson, J.W, "Regional Analysis: An Interindustry Model of Utah", The Review of Economics adn Statistics, XXXVII, 4, pp.368-383.

[12] Miernyk, W.K, Impact of the Space Programme on a Local Economy, West Virginia University Library, 1967.

negative results. In the Tayside study efforts were not made to estimate sectoral consumption functions due to lack of time needed to gather time series data on consumption patterns. It is therefore assumed that consumption functions are linear and homogeneous for every sector in Tayside. This suggests that consumption is directly proportional to income.

Table 7.11 shows direct, indirect and total income created by increasing final sales by £1. Column one of this table gives the amount of direct income generated by a £1 increase in final demand. This includes wages and salaries, proprietors' income, etc, paid to households by a sector to produce £1 worth of additional goods for final demand. The figures for direct income change were obtained from table 7.2. Column two shows the direct and indirect income changes associated with the changes in final sales. The figures in this column were derived as follows:

$$\sum_{j=1}^{25} r_{ij} \cdot a_{Hj} \qquad (i = 1 \ldots\ldots\ldots 25)$$

where r_{ij} is the direct and indirect requirements from industry j to meet the increase in final demand of sector i. a_{Hj} is the direct payments to households. The r_{ij} are row entries of the inverse matrix 1, (see table 7.3) which excludes the households as a processing sector. Thus type one income multipliers appearing in column four, are derived as follows:

$$\frac{\sum_{j=1}^{25} r_{ij} \cdot a_{Hj}}{a_{Hj}} \qquad (i = 1 \ldots\ldots\ldots\ldots 25)$$

Table 7 - 11

Changes in Income of the Tayside Region associated with changes in Final Demand, by one £ : Type One Multipliers

	Sector	Direct Income Change 1	Direct plus Indirect Income Change 2	Indirect Income Change 3	Type One Income Multipliers 4
1.	Agriculture	0.5432	0.7133	0.1702	1.3132
2.	Fishing	0.3140	0.4489	0.1349	1.4298
3.	Quarrying & Oil Exploration	0.4801	0.5629	0.0828	1.1726
4.	Food Products	0.0967	0.2205	0.1238	2.28
5.	Brewing, Soft Drinks & Spirits	0.0727	0.1508	0.0781	2.074
6.	Oil Products & Chemicals	0.0525	0.1156	0.0631	2.201
7.	Metal & Metal Products	0.116	0.16006	0.044	1.3798
8.	Mechanical Engineering	0.3441	0.4482	0.1041	1.3026
9.	Instrument Engineering	0.2886	0.4418	0.1532	1.5307
10.	Electrical Engineering	0.2174	0.2521	0.0347	1.1598
11.	Shipbuilding & Marine Eng.	0.3372	0.4235	0.0863	1.2559
12.	Textiles	0.3351	0.4263	0.0912	1.272
13.	Clothing	0.3829	0.5036	0.1207	1.315
14.	Building Materials	0.349	0.4873	0.1383	1.396
15.	Timber Products	0.1106	0.2093	0.0987	1.892
16.	Paper, Printing & Publishing	0.0944	0.1611	0.0667	1.706
17.	Rubber & Plastic Products	0.2907	0.3917	0.101	1.347
18.	Construction	0.2848	0.4357	0.1509	1.53
19.	Utilities	0.1557	0.2996	0.1439	1.924
20.	Transport	0.214	0.3386	0.1246	1.5824
21.	Communications	0.6525	0.6762	0.0237	1.036
22.	Distribution	0.1025	0.1699	0.0674	1.6578
23.	Finance Services	0.635	0.6839	0.0488	1.0769
24.	Professional, Business & Other Services	0.7085	0.7456	0.0371	1.0523
25.	Local Government	0.4446	0.7076	0.263	1.5916

Column five of table 7.12 shows the direct, indirect and induced changes in household income resulting from changes in final demand. The figures given in this column are the entries of the household row of the inverse matrix 2 (see table 7.4). Type two income multipliers were estimated by dividing column five by column one of table 7.11.

The type one income multipliers for Tayside vary from 2.2802 to 1.0364. The food product sector recorded the highest level for the type one income multiplier while communication produces the lowest type one multiplier in Tayside. The wide range of variations in type one income multipliers is a result of various factors, ie, differences in production techniques, inter-industrial dependence, amount of leakages, etc, and some of these factors will be discussed below.

The direct effects on income are high in sectors which use more labour intensive techniques. The type one multipliers in effect tend to become low in these sectors because of large value in the denominator. This is clearly visible in table 7.11, which shows low values of type one multipliers for professional and business services, finance services and shipbuilding. On the other hand, direct income change for the capital intensive sectors is low and it has resulted in the production of high level type one multipliers. The food products, and oil products and chemicals sector for example, have the highest value for type one mainly because of the low level of direct income change.

It can be seen that some sectors in Tayside have higher degree of linkages with the other local sectors. This leads to high indirect effects and so high value type one income multipliers. For example, the local government in Tayside has the highest level of indirect income change due to its more pronounced inter-relationships with other regional producers. This has clearly meant that food producers and local government have recorded a high value for type one multipliers. These type one multipliers are also larger for paper, printing and publishing, and for the transport sectors because of a higher level of indirect effects.

The degree of indirect income change is affected by the amount of leakages from the regional economy. For example, quarrying and oil exploration, metal and metal products and electrical engineering sectors produce low values for type one income multipliers partly because of a high amount of leakages which cause the production of low indirect income changes. In contrast, the service sectors have a high degree of direct income changes because most of their expenditure consists of wages, salaries and other payments, rather than buying goods from regional producers. However, the leakages from the services are much lower when compared to the manufacturing sectors. This has clearly produced a somewhat high degree of type one income multipliers for services, particularly for utilities and transport.

As shown in table 7.12, type two income multipliers are greater than the type one for every sector. This is due to induced income changes associated with the changes in final demand. However, it is seen that the size of type two multipliers for Tayside vary from 2.9045 for food products to 1.32 for communication.

Table 7.12

CHANGES IN INCOME OF THE TAYSIDE REGION ASSOCIATED WITH CHANGES IN FINAL DEMAND, BY £1 (TYPE 2 MULTIPLIERS)

	Direct, Indirect & Induced Income Change	Induced Income Change	Indirect & Induced Income Change	Type 2 Income Multipliers
	5	6	7	8
1. Agriculture	0.90821	0.26588	0.36511	1.67214
2. Fishing	0.57192	0.25738	0.25792	1.8214
3. Quarrying & Oil Exploration	0.71713	0.10235	0.23703	1.4937
4. Food Products	0.28087	0.1419	0.18417	2.90455
5. Brewing, Soft Drinks & Spirits	0.19210	0.11259	0.1194	2.64236
6. Oil Products & Chemicals	0.14725	0.03069	0.09474	2.8047
7. Metal & Metal Products	0.20389	0.0226	0.08789	1.75767
8. Mech. Engineering	0.57097	0.1673	0.22687	1.65931
9. Instr. Engineering	0.56275	0.21593	0.27415	1.94993
10. Elec. Engineering	0.32118	0.08208	0.10378	1.47736
11. Shipbuilding & Marine Engineering	0.53949	0.13852	0.20229	1.59991
12. Textiles	0.54302	0.11963	0.20792	1.62047
13. Clothing	0.64115	0.25567	0.25825	1.67446
14. Building Materials	0.62072	0.25411	0.27172	1.77856
15. Timber Products	0.26657	0.11736	0.15597	2.41022
16. Paper, Printing & Publishing	0.20522	0.05145	0.11082	2.1739
17. Rubber & Plastic Products	0.49896	0.19555	0.20826	1.7164
18. Construction	0.55505	0.05584	0.27025	1.94891
19. Utilities	0.38127	0.10052	0.22557	2.44874
20. Transport	0.43132	0.05002	0.21732	2.0155
21. Communications	0.86143	0.16467	0.21208	1.3202
22. Distribution	0.21647	0.047882	0.113962	2.1119
23. Finance	0.87157	0.10494	0.23657	1.37255
24. Professional, Business & Other Services	0.94977	0.0982	0.23127	1.34053
25. Local Government	0.90141	0.45778	0.47681	2.02746

Local government produces the highest induced income changes responding to the change in final demand in Tayside. These induced income effects of local government are much greater than its direct and indirect income changes. This means that the change of sales to final demand in local government generates a high demand for consumer goods. This point can be examined further in relation to the type two output multipliers. As was discussed earlier, it produces the largest value for type two multipliers because of a high degree of inter-industrial dependence and a low level of leakages. This generates more household income. Thus the increase in final demand by £1 multiplies the household income 2.03 times. Agriculture, fishing, clothing, and building materials also show higher induced income changes.

It is however important to note that the income multipliers need to be related both to the direct household coefficients of the Tayside domestic flow coefficients table and to changes in final demand. Without incorporating these two variables, income multipliers whether type one or two cannot be used as meaningful yardsticks to measure sectoral performance in the Tayside economy. For example, the type one income multiplier for food products is 2.28 and the type two multiplier is 2.9045. Given a £1 million increase in sales to final demand the resulting total income changes would be £220,495, (2.28 x 0.0967 x £1 million), and £280,860 for type one and two respectively. Assuming the same amount of addition to final demand the resulting income changes in the quarrying and oil exploration sector would be £562,965 and £717,155. A £1 million increase in the final demand of local government would generate an additional income of £707,625 in the first round and £901,400 in the other successive rounds. Thus, although the type one and two income multipliers are larger for the food products than for local government and quarrying and oil exploration, the additional total income created in the Tayside economy by increasing its final demand is smaller than the latter sectors.

The values of the type two income multipliers are considered to be a constant multiple of the values of the type one income multipliers. Hirsch pointed out that the correlation coefficient between type one and two multipliers is 0.97[13] and Sandoval showed that this coefficient is always equal to one[14]. This kind of constant relationship between type one and two income multipliers can be seen also, in the Tayside income multipliers because of the assumption of a linear and homogeneous income consumption function.

The variations in the income multipliers reflect some important characteristics of individual sectors' of the economies. The size of income multipliers, for example, depends on the size of the area concerned. Leakages, particularly of imports, are smaller in large areas than in smaller ones. When leakages are smaller, the income multipliers tend to increase.

This point can be examined further by comparing Tayside's income multipliers with those of other regions. Table 7.13 gives a

---

[13] Hirsch, W.Z, "Inter-Industry Relations of a Metropolitan Area", The Review of Economics and Statistics, Vol XLI, No 4, 1959, 360-369.

[14] Sandoval, A.D, "Constant Relationship between Input-Output Income Multipliers", The Review of Economics and Statistics, Vol 49, 1967, 599-600.

comparison of income multipliers in Tayside and Shetland[15]

This table shows considerable variations in the income multipliers between the two regions. Except for local government and communications, income multipliers for other sectors given in the table, are higher in Tayside than in Shetland. These variations are partly attributable to direct income changes, partly to differences between the size of the population in the two regions, and partly to differences in the amount of leakages and the degrees of inter-industrial dependence. Also differences in sectoral aggregation, sector classification and above all, differences in economic structures have affected the income multipliers in the two economies differently. The higher income multipliers of Tayside relative to Shetland mainly indicate its smaller amount of leakages and its larger degree of intra-regional industrial dependence.

---

[15] For details of Shetland income multipliers see McNicoll, I H, The Shetland Economy, Research Monograph, No 2, The Fraser of Allander Institute, 1976.

Sectors	Direct Income Changes		Type 1 Multipliers		Type 2 Multipliers	
	Tayside	Shetland	Tayside	Shetland	Tayside	Shetland
Agriculture	0.543	0.518	1.3122	1.26	1.672	1.46
Textiles	0.335	0.474	1.2721	1.08	1.62	1.24
Construction	0.285	0.246	1.53	1.2	1.949	1.38
Communications	0.652	0.930	1.0364	1.07	1.32	1.23
Local Government	0.444	0.127	1.5916	5.08	2.027	5.66

Table 7.13 INCOME MULTIPLIERS IN TAYSIDE AND SHETLAND

7.7.3 EMPLOYMENT MULTIPLIERS

The examination of the impact of changes in final demand on the labour market in Tayside is of vital importance because unemployment is one of the Region's most difficult problems. Employment multipliers quantify the effects of changes in final demand on the number in employment. However, in deriving employment multipliers the relationship between the number of employees and regional output by sector needs to be examined. Thus the employment multipliers are based on the employment production functions, which facilitates the quantification of the exact changes in the number in employment in relation to changes in production levels.

It can be seen that no data is available on Tayside for 1979 to measure this relationship accurately. In practice, the number of employees may not increase at the same rate as sectoral output. This implies that when sectoral output increases, the existing labourforce can be used, to a certain extent, to meet the increased demand in final sales. This is partly because there may be some degree of under employment in some sectors. The existing labourforce can be used in this process, by increasing their efficiency through the provision of bonuses, overtime payments, etc. Additionally, some sectors, specifically manufacturing sectors, tend to use more capital intensive machinery in place of labour due to the high cost of labour. It is also seen in Tayside that there are some workers such as students and the unemployed who provide their services seasonally mainly in the business and other services sector and in agriculture, without being recorded in the business accounts. It is, therefore, difficult to quantify accurately the employment production functions for each sector in Tayside's economy. Due to lack of time series data on employment and production over the past few years, it is assumed that the relationship between employment and production is linear and positive. This implies that sectoral employment is directly proportional to sectoral output. Based on this assumption, the employment production function can be expressed as follows:

$$E_i = k_i X_i$$

where E_i is the number of employees in sector i, X_i is the sectoral output and k_i is the constant employment/production coefficient for sector i. Table 7.14 shows the type one employment multipliers for Tayside. Column (i) of this table gives employment production coefficients (E/X). Column (ii) presents direct and indirect employment changes which were derived as follows:

$$C_i = \sum_{j=1}^{25} r_{ij} k_i \qquad (i = 1 \ldots\ldots\ldots 25)$$

where C_i is the direct and indirect employment changes and r_{ij} is the total direct and indirect production required from sector j to provide additional sales worth £1 to the final demand of sector i. Thus r_{ij} is an entry in the inverse matrix 1. Column (iv) gives the type one employment multipliers which were computed as follows:

$$\sum_{j=1}^{25} r_{ij} k_i \Big/ k_i$$

The type one employment multipliers quantify the direct and indirect changes in employment resulting from an increase in final demand by £1. The type two employment multipliers measure the induced effects of employment associated with the change in final demand. This means that in the first round, when the final demand increases, more employment opportunities are created and this directly effects an increase in household income. In the next successive rounds, household consumption expenditure increases and this is followed by increases in local production. The increase in local production generates more employment. The direct, indirect and induced employment effects are given in man years.

Table 7.14 shows that agriculture, communications, finance, professional and other business services, and textiles in Tayside use more labour-intensive techniques, while engineering, food products, timber products, and several other sectors, use more capital-intensive ones. This factor has clearly affected the size of the employment multipliers. The sectors which use more capital intensive techniques tend to produce high employment multipliers, and vice versa. On the other hand, sectors which have large inter-sectoral relationships within the region produce high employment multipliers, although their direct employment changes are comparatively lower. This is true especially in the cases of construction and distribution.

However, some conceptual problems arose from the assumption upon which the employment multipliers are based. When a sector employs few people due to the use of more capital-intensive inputs, it is likely to produce small employment/production coefficients. In turn, this results in large multipliers. For example, the employment multiplier is high

Table 7.14

THE TAYSIDE REGION: TYPE 1 EMPLOYMENT MULTIPLIERS

	E/X	Direct + Indirect Employment Change	Indirect Employment Change	Type 1 Multiplier
	(i)	(ii)	(iii)	(iv)
1. Agriculture	0.14178	0.166555	0.02477	1.1747
2. Fishing	0.08193	0.082051	0.000121	1.00147
3. Quarrying & Oil Exploration	0.018025	0.046128	0.028103	2.5591
4. Food Products	0.020645	0.030579	0.009934	1.48118
5. Brewing, Soft Drinks & Other Spirits	0.01452	0.015941	0.001421	1.09786
6. Oil Products & Chemicals	0.025963	0.049293	0.02333	1.8985
7. Metal & Metal Products	0.02007	0.028167	0.008097	1.4034
8. Mech. Engineering	0.06491	0.077036	0.01216	1.1971
9. Instr. Engineering	0.059484	0.072930	0.013446	1.226
10. Elec. Engineering	0.04916	0.054099	0.004939	1.10046
11. Shipbuilding & Marine Engineering	0.019808	0.029100	0.009292	1.4691
12. Textiles	0.09876	0.121034	0.02227	1.22553
13. Clothing	0.08964	0.090284	0.00064	1.00718
14. Building Materials	0.07597	0.078862	0.002892	1.03806
15. Timber Products	0.02613	0.033139	0.007	1.26823
16. Paper, Printing & Publishing	0.02553	0.038800	0.01327	1.51978
17. Rubber & Plastic Products	0.06575	0.068397	0.002647	1.04026
18. Construction	0.04466	0.111945	0.067285	2.5066
19. Utilities	0.02969	0.055020	0.02533	1.85315
20. Transport	0.03374	0.086064	0.052324	2.5508
21. Communications	0.13044	0.140604	0.01016	1.07792
22. Distribution	0.08083	0.164253	0.083423	2.03207
23. Finance Services	0.119266	0.146748	0.027482	1.23042
24. Professional, Business & Other Services	0.18268	0.239400	0.05672	1.31048
25. Local Government	0.12875	0.132635	0.003885	1.03017

for quarrying and oil exploration, mainly because of a small denominator, ie, small k_i. Theoretically this suggests that a £1 increase in final demand in quarrying and oil exploration creates an additional 3.44 man years in the economy[16]. It is noted that this sector has comparatively low direct, indirect and induced employment changes which indicate a low level of inter-industrial relationships and a large degree of leakages from the economy. Therefore, although it may theoretically possible to show that quarrying and oil exploration creates a relatively high number of additional man years given an increase in final demand, it is hard to find any economic justification for this situation.

This weakness in the employment multiplier is clearly visible in the employment multipliers computed for the Boulder economy, but Miernyk has not elaborated this point in his analysis[17]. Table 7.16 shows employment multipliers and employment production coefficients for the Boulder economy. Real property rentals which have the lowest employment/production ratio produces the largest type one and two employment multipliers. In contrast, the apparel and accessories sector which has the largest E/X ratio produces small type one and two employment multipliers. This suggests that the employment multipliers alone cannot give proper directions in framing regional policies for creating additional employment opportunities.

However, it is found that the results of multiplier analysis depend on the assumptions of linear and homogeneous consumption functions

---

[16] See table 7.15.

[17] Miernyk, W H, et al, Impact of the Space Programme on a Local Economy, West Virginia University Library, 1967.

Table 7.15

THE TAYSIDE REGION: TYPE 2 EMPLOYMENT MULTIPLIERS

	Direct, Indirect & Induced Employment Change	Induced Employment Change	Direct Employment Change E/X	Type 2 Multipliers
	(v)	(vi)	(vii)	(viii)
1. Agriculture	0.173455	0.0069	0.14178	1.2234
2. Fishing	0.084314	0.002384	0.08193	1.029
3. Quarrying & Oil Exploration	0.062053	0.015925	0.018025	3.4426
4. Food Products	0.066887	0.036308	0.020645	3.2398
5. Brewing, Soft Drinks & Other Spirits	0.032649	0.016708	0.01452	2.2485
6. Oil Products & Chemicals	0.156338	0.107045	0.025963	6.02156
7. Metal & Metal Products	0.029695	0.001528	0.02007	1.4795
8. Mech. Engineering	0.078913	0.001877	0.06491	1.21572
9. Instr. Engineering	0.077237	0.004307	0.059484	1.29845
10. Elec. Engineering	0.054802	0.000703	0.04916	1.11476
11. Shipbuilding & Marine Engineering	0.029833	0.000733	0.019808	1.506108
12. Textiles	0.127742	0.006708	0.09876	1.29345
13. Clothing	0.091625	0.001341	0.08964	1.02214
14. Building Materials	0.08033	0.001468	0.07597	1.05739
15. Timber Products	0.034879	0.00174	0.02613	1.33482
16. Paper, Printing & Publishing	0.045168	0.00636	0.02553	1.76921
17. Rubber & Plastic Products	0.069359	0.000962	0.06575	1.05488
18. Construction	0.223536	0.111591	0.04466	5.00528
19. Utilities	0.105256	0.05023	0.02969	3.54516
20. Transport	0.131198	0.04512	0.03374	3.8885
21. Communications	0.143985	0.00338	0.13044	1.1038
22. Distribution	0.316354	0.152101	0.08083	3.91381
23. Finance Services	0.161280	0.014532	0.119266	1.35227
24. Professional, Business & Other Services	0.387601	0.148201	0.18268	2.12174
25. Local Government	0.17424	0.0416	0.12875	1.35332

Table 7.16

EMPLOYMENT MULTIPLIERS FOR THE BOULDER ECONOMY[18]

Sectors	E/X	Type One Multipliers	Type Two Multipliers
Apparrel and Accessories	0.1612	1.10	1.24
Real Property Rentals	0.0012	19.92	28.50
General Merchandise	0.1145	1.15	1.32
All Other Manufacturing	0.0420	1.18	1.54
Food and Kindred Products	0.0263	1.48	1.95
Local Government	0.1008	1.05	1.28

and linear employment production functions. In the light of the above analysis one can argue that these assumptions may limit the practical use of the multipliers. It is seen that some modifications might have been introduced in particular for the assumptions. As Moore and Peterson pointed out[19], the assumption of linear and homogeneous consumption functions results in over-estimating the induced effects of income associated with changes in final demand. To avoid this weakness the sectoral consumption functions might have been derived for Tayside by using Scottish consumption functions. This use of Scottish consumption functions may not be too impractical because Tayside is a fair representative of the Scottish economy

[18] Miernyk, W H, et al, Impact of the Space Programme on a Local Economy, West Virginia University Library, 1967.

[19] See Moore and Peterson, op. cit., pp.358-383.

in terms of GRP, employment, industrial structure, and population. The use of these consumption functions permits some flexibility to be introduced into the model which helps to improve the results of the income multipliers.

Also some flexibility needs to be introduced to the employment production functions. The time series data on employment and output for the past years can be made available for Scotland from confidential sources such as disaggregated data of the census of production and the census of employment. This would allow the computation of E/X ratios for Scotland, and by using these data with the necessary adjustments employment production functions for Tayside might be estimated. The results obtained in this way would be superior to the results obtained assuming the proportionality of employment to the level of gross output.

CHAPTER 8

AN ASSESSMENT OF THE USE OF THE TAYSIDE INPUT-OUTPUT TABLES FOR REGIONAL ECONOMIC PLANNING

INTRODUCTION

As was discussed in chapter three, Tayside, since the late 1970's, has been suffering from an industrial decline in terms of employment with a higher rate of unemployment compared to other regions in the rest of Scotland and the U.K., a rising level of emigration and a slow rate of economic growth. The Tayside Regional Council and the District Councils have shown considerable interest in coping with this economic crisis and they have formed policies and proposals in the past Tayside Structure Plans with the main objective of stimulating Tayside industry and creating employment opportunities. The succeeding sections of this chapter will assess how planners can incorporate Tayside input-output tables in various stages of the production of the regional Structure Plan i.e. in identifying regional problems and in determining aims and objectives, in formulating policies and proposals, and in evaluating impacts of proposed strategies on the rest of the economy.

8.1 TAYSIDE STRUCTURE PLAN AND ECONOMIC PLANNING

If the economic component of regional planning is to have any meaning, local authorities need to be concerned with the industry and commerce in their region. This can be clearly seen from the recommendations of the Royal Commission on Local Government in Scotland. It said that "the strategic planning for a region contains elements, which are classified as intelligence, economic planning, land use planning and implementing services, which include industrial development, transportation and roads, etc. Intelligence means collecting of relevant information, statistics, and projects. Every department, public or private needs to gather information before policy can be decided for the future."[1] It is also stated that "the functions of structure plan will not be merely land-use planning in the accepted sense, but will involve the formulation of an economic strategy for the region relating to patterns of settlement, the development of communications and centres of population and the use of resources particularly land and finance."[2] This implies that the role of the structure plan centres mainly on regional economic planning, and its other functions such as environment, transportation and roads etc, provide the facilities needed to support the regional economic and physical development.

The prime aim of the Tayside structure plans during the past years has been to achieve the provision of an adequate number and range of job opportunities throughout the region. In order to achieve this aim, the Regional council has proposed an objective in the plan i.e. to obtain maximum return on investment capital.[3]

---

1. H.M.S.O., The Report of the Royal Commission on Local Government in Scotland 1966-69, Cmnd 4150, p59.

2. H.M.S.O., White Paper on the Reform of Local Goverment in Scotland, Cmnd 4583, 1971, para 24.

3. Tayside Regional Council. Tayside Structure Plan Consultative Draft 1979, p5.

However, in turning such aims and objectives into policies and strategies[4], there are some circumstances when such aims and objectives are in conflict. For example, when the policies and proposals are assigned to increase employment it may not be realistic to anticipate maximum return on investment capital, because by increasing number of employees, the cost of production may tend to increase resulting in a low level of return to invested capital.

The other side of the coin is that the creation of jobs will depend, to a large extent, upon the investment decisions of the public and private sectors in the regions. Once these decisions are made, the Regional Council is responsible for producing policies and proposals within these financial resources. Therefore, the Regional council needs to take into account direct and indirect effects which may be created in achieving the plan's aims and objectives.

In deriving strategies also, the Tayside structure plans give priority to the region's industrial development. For example, the strategy of 1980 Structure Plan is described as follows: the strategy is to attempt to create a wide choice of both industrial location and housing opportunity. In the light of the current economic position and national policy, the Regional council intends to

---

4. "Policy" is defined as a chosen course of action, in pursuance of an aim which guides decision making. "Strategy" can be defined as decisions in a plan which co-ordinates the aims and determine broadly how they will be achieved. A strategy will, therefore, consist of a series of inter-related and compatible policies and proposals.

give priority to the needs of industry and this is reflected in the strategy for provision for industrial land in Tayside.[5] Therefore, it is of importance to assess to what extent the present Tayside input-output tables can be a useful analytical tool in forming the aims and objectives of structure plans, in deriving necessary policies and proposals and also in measuring their implications.

8.2.1. FORMULATIONS OF AIMS AND OBJECTIVES PROVISION OF INFORMATION AND REGIONAL ACCOUNTS

Tayside planners need to identify the problems and key issues of the region in forming the plan's aims and objectives. They normally gather this information from Regional Report of the Survey. Before the construction of the structure plan, the Secretary of State is presented with a regional report of the survey by each region in Scotland. The objective of producing this report "is to carry out a survey and an analysis of conditions within the region in order to identify the key issues to which policies and proposals are addressed" [6] One can examine what kind of information this report provides to planners, and whether this information is sufficient to identify regional problems and to form the plan's aims and objectives.

As the Town and County Planning (Scotland) Act 1969 specifies, the "Survey should cover the principal physical and economic characteristics of the area (including the principal purposes for which the land is used); the size, composition and distribution

---

5. Tayside Regional Council. Tayside Structure Plan 1980, p48.
6. Tayside Regional Council. Tayside Structure Plan; Report of the Survey 1980, 1.

of population; and communications transport system and traffic characteristics. The survey should collect information to indicate the trends, problems and potential of the area, to aid in the selection of the main aims of the plan, to indicate ways of achieving the stated aims of the plan, and to measure the effects of implementation of the plan's proposals, other changes and progress towards the stated aims."[7] However, in practice, the regional report of the survey of the Tayside Structure Plan, 1980, for example, has given little consideration to the fulfilment of the requirements of the Town and Country Planning Act, 1969. For example, the Tayside Report of the Survey 1980, provides some employment forecasts based on population projection; but it has not put forward enough details by sectors to highlight the problem areas in Tayside which need the planner's attention.

As was discussed in Chapters 3 and 7, the input-output study for the Tayside Region provides the planners with a large amount of data and information for the economy disaggregated into sectors. This facilitates a more comprehensive analysis of the economic and structural elements of the region, and this analysis helps them to identify regional problems. The Tayside input-output accounts (see table 7.1) provide planners with regional accounts such as gross regional productions; household income; trade balance; sectoral economic performance in terms of their contribution to regional gross production, and household income; and regional inter-sectoral dependence.

---

7. Scottish Development Department. Development Plans; Town and Country Planning (Scotland) Act 1969, HMSO, 1971, p8.

FORECASTING

The Tayside reports of the survey provide population and employment projections which form the basis for the policies and proposals of the regional structure plans and local plans. These projections have been carried out based on some crude assumptions. For example, the population projections in Tayside reports of the survey, between 1976 and 1991 depend on an assumption which implies that the population trend during the period 1961 to 1975 would be applicable for the projected period from 1976 to 1991. The policies and proposals based on these projections may not help to achieve the plan's objectives. This is because that population trend is mostly determined by the physical, economic, and social environment in which people live, and these factors should be given consideration in the population projections. Also, the projections on Tayside labour supply have been carried out on the basis of population projections which were discussed above, without taking other variables such as the level of the region's migration, into account. The Report of the Survey 1980 states "that the forecast of the number of jobs which may become available has been prepared on the basis of optimistic and pessimistic assumptions about the future performance of the regional economy."[8] However, this report does not state what these optimistic and pessimistic assumptions are and how the planners derived them.

The changing trade pattern can influence the structure of a regional economy. Regional levels of output, and the number of employees are affected by the changes in national and local final demand, production

8. Tayside Regional Council, Tayside Structure Plan; Report of Survey 1980, p18

mix, and techniques of production. These variables need to be given consideration in the regional projections and the resulting projections will be more realistic when used in regional planning.

The Tayside input-output tables can be used as a forecasting model for the projections of regional output and regional final demand, and for the projections of trade relationships of intra-regional sectors. In this process some assumptions have to be made about the future economic relationships. For example, in forecasting regional output, it is assumed that the existing input coefficients of each sector will be applicable for the projection period, which implies that the existing trading pattern of Tayside remains constant during this period.

Planners may need to forecast the regional output, say for the year 1984, based on the Tayside input-output tables. In this example, final demand and the Tayside domestic flow coefficients are the independent variables and the level of gross output is the dependent variable. By using these variables regional gross outputs for 1984 can be projected as follows:

$$\text{if} \quad X^{1979} = (1 - A^{Ty})^{-1} \, Y^{1979} \qquad (1)$$

$$\text{then} \quad X^{1984} = (1 - A^{Ty})^{-1} \, Y^{1984} \qquad (2)$$

Where A^{Ty} is the Tayside domestic flow coefficients

X is the vector of gross output and Y is the vector of final demand. In equation (2) Y, for 1984, needs to be projected independently by using time series or by using national projections on final demand.

These forecasts are useful for the decision makers to identify future requirements of goods and services associated with the increase of final demand. In some circumstances, the expected increase in final demand may require an increase in output levels in some sectors in excess of their existing capacity. Thus, given the forecasts of final demand and outputs of Tayside, firms can adjust their industrial strategies in advance to meet the future requirements of the region. The regional planners can also assess the need for additional industrial assistance for the region's sectors in terms of finance, physical development programmes etc.

The forecasting model based on input-output tables facilitates the projection of the manpower requirements of the region associated with the changes in final demand and regional outputs. The projection of gross output can be translated into forecasts of manpower by using employment-output ratios of individual sectors derived for the base year. Planners can use these projections in selecting investment programmes in accordance with the aims of Tayside structure plan. For example, one of the aims of Tayside Structure Plan 1980 was to increase the level of employment opportunities. Tayside planners can forecast the manpower requirements of a series of investment projects using input-output tables and they can give priorities for the projects which create demand for a large number of employees in the region.

8.2.2. FORMULATION OF STRATEGIES

Policies and strategies in the Tayside structure plan are determined mainly on the basis of the information and projections provided by structure plan's report of the survey. As was discussed, these surveys hardly provide planners with detailed economic analysis which can direct them to derive efficient policies and strategies. The Tayside input-output tables can play an important role in formulating regional strategies which can be examined in the following section with reference to two approaches, namely linkage analysis and selection of key sectors, and analysis of degree of sectoral interdependence.

LINKAGE ANALYSIS AND SELECTION OF KEY SECTORS

In regional planning it is normally necessary to undertake a series of projects which produce favourable effects on the flow of income and regional employment. Because of limitations on resources such as finance, planners may be compelled to select some among the proposed projects for implementation. This need can be met by assessing these projects with efficient criteria which help to identify key sectors of the economy. The Tayside input-output tables provide guidelines in selecting such key sectors by analysing backward and forward linkages which exist among the regional sectors. By doing so, planners can give priorities to the projects in the selected key sectors. Hirschman pointed out that "development policy must attempt to enlist these well known backward and forward effects; but it can do so only if there is some knowledge as to how different economic activities score with respect to these effects." He also stated that the "approach toward the establishment of an industry through backward and forward linkage illustrates the similarity of economic development to a jigsaw puzzle."[9] This means that the degree of inter-sectoral relationships plays the main role in an approach which suggest strategies for regional economic development through the key sectors.

---

9. Hirschman, A.O. The Strategy of Economic Development, Yale University Press, 1958, p82.

   For details also see, McGilvray, J.W. Linkages, Key Sectors and Development Strategy, The Fraser of Allander Institute, Discussion paper, 4, 1977.

Some argue that by concentrating regional resources on the key sectors, output of the region can be increased more rapidly than if these resources were employed in any other sectors in the region. Thus, in regional planning it is important to encourage those sectors that would contribute more than their proportionate share to the process of growth of the economy. Such strategic key sectors in a region can be identified with reference to three approaches put forward by Hirschman, Rasmussen, and Hazari, for selection of industrial potentialities.

Hirschman's linkage concept provides a criterion for evaluation of industrial sectors from the view point of Tayside's input-output accounts. Although the existence of linkage effects in industrial development were discussed before in terms of externalities and complementaries, these concepts were not able to provide any possibility of empirical testing. Hirschman's linkage concept enables the quantification of these linkage effects based on empirical data established in input-output accounts. Backward linkage or input provision is the inducement to establish new industries due to the demand for intermediate inputs. Forward linkage or output utilization can, on the other hand, be defined as the inducement to establish new industries resulting from supply in excess of domestic demand.

Hirschman's criterion for identifying key sectors extends further and he classified industrial activities into"Directly Productive Activities, (DPA), and "Social Overhead Capital", (SOC). The SOC activities are basic industrial activities required to provide intermediate input demands. Such activities are normally non-tradeable and these are characterised by technical indivisibility and high capital output ratios. According to Hirschman's criterion, unbalanced growth occurs through shortages or surpluses by the differences between SOC activities and DPAs. He pointed out that "the properties of balanced growth advocate a harmonious programming approach to industrial development planning."[10] This implies that the sectors which provide SOC activities such as infra-structure facilities provided by the Tayside Regional Council and the District Councils, and the processing sectors which produce tradeable goods should be linked closely in order to achieve the planning objectives.

It may be noted, however, that the degree of two kinds of linkages, backward and forward, is associated with industrial interdependence. Some argue that the concept of linkages is most likely to apply in underdeveloped economies. It can be clearly seen that most of the cells in the structural matrices in input-output tables computed for underdeveloped economies indicate zero values. This means such economies are poor in relation to the industrial interdependence, and backward and forward linkages. Therefore, the linkage analysis is more practicable for the developed economies from the view point of industrial inter-relatedness. When the key sectors are identified according to the high degree of linkages, "they should receive high rankings in any development program, not only on account of the intrinsic usefulness of their output, but because of further development stimuli which are likely to emanate from them."[11]

Chenery and Watanabe studied the relative importance of various industrial sectors of a developed economy using Hirschman's

10. Hirschman, op.cit., p94.
11. Hirschman, op.cit., p104.

linkage analysis.[12] It shows an appraisal of sectoral performance based on linkage analysis can provide important guidelines for the direction of industrial investment budget for future development. The backward and forward linkages among the sectors in the Tayside economy were derived by using Tayside input-output accounts as shown follows:

$$U_j = \frac{\sum_{i=1}^{26} Q_i}{X_j} \times 100 \qquad \text{and} \qquad (3)$$

$$W_i = \frac{\sum_{j=1}^{26} V_j}{X_i} \times 100 \qquad (j,i = 1,2,3..26) \qquad (4)$$

where U_j : Backward linkages
W_i : Forward linkages
Q_i : Value of intermediate inputs
X_j : Value of total inputs
V_j : Trade transactions among processing sectors and
X_i : Value of gross outputs.

The sectoral rankings for Tayside based on these linkage measures are given in Table 8.1. This suggests that industrial investment can be distributed according to the hierarchy of priorities revealed in this table. Thus, sectors like local government, agriculture, professional business and other services, quarrying and oil exploration, rubber and plastic products, building materials, clothing, textiles, and instrument engineering receive high priority

---

12. Chenery, H.B., and Watanabe, T. "International Comparisons of the Structure of Production," Econometrica, Vol 26, 1958.

Table 8 - 1.

Backward and Forward Linkages based on Hirschman's Criterion,

		U_j	W_i	Ranking on basis of U_j	Ranking on basis of W_i
1.	Agriculture	92	55	2	8
2.	Fishing	64.4	86	12	4
3.	Quarrying & Oil exploration	71	43	6	12
4.	Food Products	54	22	15	14
5.	Brewing, Soft Drinks & Other Spirits	34	16	21	16
6.	Oil Products & Chemicals	21.1	47	23	11
7.	Metal & Metal Products	26.5	9	22	21
8.	Mechanical Eng.	64.9	11	11	19
9.	Instrument Eng.	66	12	9	18
10.	Electrical Eng.	34	5	21	22
11.	Shipbuilding	60	12	14	18
12.	Textiles	61.5	13	13	17
13.	Clothing	73.9	9	4	21
14.	Building Materials	65.8	53	10	9
15.	Timber Products	37	21	20	15
16.	Paper, Printing & Publishing	26.5	10	22	20
17.	Rubber & Plastic Products	67.6	21	8	15
18.	Construction	68.7	61	7	7
19.	Utilities	49.4	99.6	18	1
20.	Transport	53	61	17	7
21.	Communications	72	63.5	5	6
22.	Distribution	41	51	19	10
23.	Finance Services	07	98	24	2
24.	Professional, Business & Other Services	79	71	3	5
25.	Local Government	97	33	1	13
26.	Households	53.5	89	16	3

in terms of backward linkages. From the point of view of forward linkages the service sectors and sectors like construction, fishing and agriculture receive high priority. This ranking also shows that the backward linkages in the Tayside economy are more prominent and important than its forward linkages. This is mainly becuase a large proportion of production of manufacturing sectors are used by customers outside the Tayside region.

These linkage measures can also be used to identify interdependence for the entire Tayside economy; relative backwardness or forwardness of Tayside with respect to industrialization compared to the same factors in other regions in Scotland and the U.K. In this comparison variations in accounting procedures should be taken into account together with differences in the construction of tables which can be experienced in different regions. However, linkage measures for recent years are not available for other regions in Scotland and the U.K. The main weakness of Hirschman's linkage analysis is that he has not considered the indirect repercussion of an increase in final demand, which might be an important planning interest.

This weakness does not exist in the methodology put forward by Rasmussen.[13] In his model, direct and indirect effects associated with changes in final demand are taken into consideration. Unlike Hirschman, Chenery and Watanabe who use only input-output accounts, Rasmussen uses the inverse matrix, $(1-A)^{-1}$, to analyse linkage relationships of an economy. His terminology on the Hirschman's linkage concepts can be outlined as Power of Dispersion (U_j) and Sensitivity of Dispersion, (W_i). The power of dispersion quantifies

---

13. Rasmussen, N.P., Studies in Intersectoral Relations, Amsterdam, North Holland, 1956.

the amount of intermediate inputs required when there is an increase in production. When the values of U_j and W_i exceed one they indicate a more than proportionate increase in intermediate demand which suggest a higher degree of linkages compared to the rest of the sectors.

The sectors in Tayside are ranked according to the importance of power of dispersion and sensitivity of dispersion which are similar to Hirschman's backward and forward linkages in terms of the interpretation of results. The method of computation can be outlined as follows:

$$\text{If} \quad R_{ij} = (1 - A^{Ty})^{-1},$$

$$\text{then} \quad \bar{R}_i = \sum_{j=1}^{26} R_{ij} \Big/ n \qquad (5)$$

$$\bar{R}_j = \sum_{i=1}^{26} R_{ij} \Big/ n \quad \text{and} \qquad (6)$$

$$\bar{R}_{ij} = \sum_{i=1}^{26} \sum_{j=1}^{26} R_{ij} \Big/ n^2 \qquad (7)$$

where n = 26

U_j and W_i can therefore be defined as follows:

$$U_j = \bar{R}_j / \bar{R}_{ij} \qquad (8)$$ (Index of power of dispersion/backward linkages)

$$W_i = \bar{R}_i / \bar{R}_{ij} \qquad (9)$$ (Index of sensitivity of dispersion/forward linkages)

Table 8.2. suggests the sectors with high backward linkages in Tayside are local government, agriculture, professional business

and other services, finance, clothing, construction, communications, quarrying and oil exploration, building materials, instrument and mechanical engineering. The sectors, such as households, distribution, professional business and other services, construction, oil products and chemicals, and transport have a higher level of forward linkages than the rest of the sectors of the economy. However, there are two sectors, namely professional business and other services,and construction which have high values for both forward and backward linkages.

Rasmussen's methodology in appraising sectors with reference to their linkage relationships is based on the concept of "averaging'. The numerators of equations (8) and (9) are the average values of all elements in columns j and rows i respectively. The denominators of these equations denote the average value of all elements of the inverse matrix, $(1 - A^{Ty})^{-1}$. However, it is clear from the theory of statistics that averages are more sensitive to extreme values of both sides. This means, in averaging, that the high and low values in a series of statistics can distort the expected results of an analysis. Thus, Rasmussen's indices may produce some misleading results and they may not be able to analyse meaningfully the structural interdependence of the Tayside economy. For example, a sector which has high degree of backward linkages may not have same level of inter-industrial relationships with all the sectors of the economy. Therefore, the main weakness of Rasmussen's method is that it disregards the spread effects in appraising inter-industrial relationships, which are of significance in assessing the degree of structural changes and diversification that could result from new investment.

Table 8 - 2.

Backward and Forward Linkages based on Rasmussen's and Hazari's Criteria

		U_j	W_i	V_j	V_i
1.	Agriculture	1.3666	0.6091	2.2824	6.546
2.	Fishing	1.0712	0.4557	2.3105	7.43
3.	Quarrying & Oil Exploration	1.1258	0.7488	2.3938	4.727
4.	Food Products	0.9288	0.7351	2.7802	4.826
5.	Brewing, Soft Drinks & Spirits	0.7456	0.5724	3.2789	5.92
6.	Oil Products & Chemicals	0.6368	1.374	3.8832	2.469
7.	Metal & Metal Products	0.6851	0.546	3.4385	6.099
8.	Mechanical Engineering	1.0584	0.525	2.3922	6.494
9.	Instrument Eng.	1.0815	0.5394	2.3532	6.375
10.	Electrical Eng.	0.7603	0.4768	3.1583	7.096
11.	Shipbuilding	1.00057	0.5289	2.622	6.978
12.	Textiles	1.0237	0.5942	2.5398	5.96
13.	Clothing	1.1525	0.4511	2.2383	7.658
14.	Building Materials	1.0951	0.4751	2.3357	7.258
15.	Timber Products	0.7936	0.5438	3.288	6.781
16.	Paper, Printing & Publishing	0.6961	0.5541	3.428	6.081
17.	Rubber & Plastic Products	1.0412	0.4719	2.377	7.178
18.	Construction	1.1345	1.5325	2.857	2.871
19.	Utilities	0.9274	0.9288	2.743	3.738
20.	Transport	0.9667	1.1079	3.0007	3.577
21.	Communications	1.1358	0.525	2.5125	6.946
22.	Distribution	0.7967	2.37	3.977	1.906
23.	Finance Services	1.1548	0.7056	2.5066	5.1864
24.	Professional, Business & Other Services	1.2136	1.6487	2.6633	2.465
25.	Local Government	1.4447	0.7167	2.0729	4.928
26.	Households	0.9712	6.2674	2.9488	1.0615

Hazari suggested that this weakness can be overcome by introducing spread effects into the linkage analysis and he defined the indices of coefficient of variation as follows:[14]

$$V_j = \frac{\sqrt{\dfrac{1}{n-1} \sum_{i=1}^{n} \left(R_{ij} - \dfrac{1}{n} \sum_{i=1}^{n} R_{ij}\right)^2}}{\dfrac{1}{n} \sum_{i=1}^{n} R_{ij}} \qquad j = 1, \ldots, n \tag{10}$$

$$\text{and } V_i = \sqrt{\frac{1}{n-1} \sum_{j=1}^{n} \left(R_{ij} - \frac{1}{n} \sum_{j=1}^{n} R_{ij}\right)^2} \Big/ \frac{1}{n} \sum_{j=1}^{n} R_{ij} \tag{11}$$

High values for V_j show that a particular sector relies heavily on one or a few sectors for its input requirements. Low V_js, on the other hand, indicate that a sector purchases inputs more evenly from other regional sectors which shows a high level of inter-industrial dependence. A similar interpretation can be applied for the V_i. Table 8.3. gives a ranking of the sectors in Tayside according to the indices of coefficients of variation, i.e., V_j and V_i, and backward and forward linkages. Since a high level of spread effects are shown by low values for V_j and V_i, these values are given in this table in decreasing order of magnitude. It shows that local

---

14. Hazari, B.R., "Empirical Identification of Key sectors in the Indian Economy", <u>The Review of Economics and Statistics</u>, p p. 301 - 305.

Table 8 - 3

Ranking of Sectors based on Rasmussen's and Hazari's Criteria

		U_j	W_i	V_j	V_i
1.	Agriculture	2	12	3	18
2.	Fishing	11	24	4	25
3.	Quarrying & Oil Exploration	8	8	9	8
4.	Food Products	18	9	16	9
5.	Brewing, Soft Drinks & Spirits	23	14	21	12
6.	Oil Products & Chemicals	26	5	25	4
7.	Metal & Metal Products	25	16	24	15
8.	Mechanical Eng.	12	20	8	17
9.	Instrument Eng.	10	18	6	16
10.	Electrical Eng.	22	21	20	22
11.	Shipbuilding	15	19	13	21
12.	Textiles	14	13	12	13
13.	Clothing	5	25	2	26
14.	Building Materials	9	22	5	24
15.	Timber Products	21	17	22	19
16.	Paper, Printing & Publishing	24	15	23	14
17.	Rubber & Plastic Products	13	23	7	23
18.	Construction	7	4	17	5
19.	Utilities	19	7	15	7
20.	Transport	17	6	19	6
21.	Communications	6	20	11	20
22.	Distribution	20	2	26	2
23.	Finance Services	4	11	10	11
24.	Professional, Business & Other Services	3	3	14	3
25.	Local Government	1	10	1	10
26.	Households	16	1	18	1

government, clothing, agriculture, fishing, building materials, instrument engineering, rubber and plastic products, quarrying and oil exploration provide a higher level of spread effects than the rest of the sectors on the inputs side. In relation to the distribution of output among the regional processing sectors, distributive trades, professional business and other services, oil products and chemicals, construction, transport, utilities, quarrying and oil exploration, and food products offer a higher degree of spread effects when compared to the other sectors in Tayside.

Having quantified backward and forward linkages and indices of coefficients of dispersion, the next step is to select the key sectors of the economy. According to Hirschman, a key sector is one which has high level of both forward and backward linkages. For the convenience of this analysis, sectors could be classified into a number of groups such as sectors ranked between 1 and 9, between 10 and 18 and sectors ranked between 19 and 26. Thus, sectors in the first group may be identified as key sectors. When one applies this criterion to Tayside, sectors like agriculture, professional business and other services, construction, building materials, which are in the first group of ranking can be considered as key sectors. However, these key sectors cannot be regarded as an effective guideline for planners because this does not take indirect and spread effects into account.

According to Rasmussen, key sectors are defined as those in which both U_j and W_i exceed unity. Tables 8.2 and 8.3 show the ranking of sectors according to this criterion and suggest only two sectors, namely construction, and professional business and other services, qualify as key sectors of the economy. This is because Tayside has fewer sectors which have a high level of forward linkages when compared to the number of sectors which have higher backward linkages (see Table 8.2). Therefore, this criterion also does not provide effective guidelines for regional planners in selecting key sectors.

Hazari suggested that a key sector is one in which (a) both U_j and W_i are greater than Unity and (b) both V_j and V_i are relatively low. Table 8.2. shows that only two sectors, namely construction, and professional business and other services in Tayside can meet both these propositions. This implies that Hazari has not improved Rasmussen's method significantly in selecting key sectors, although it provides planners with a useful analytical tool on sectoral inter-dependence.

Table 8.3. shows that the sectors like local government, agriculture, finance, clothing, building materials and quarrying and oil exploration lie in the first group of sectoral ranking and they offer higher backward linkages and lower coefficients of variation. This implies, first, the inter-dependence of these sectors on local processing sectors for inputs is higher than the rest of the sectors and second, these sectors generate a higher level of spread effects. This ordering of sectors would provide a rational basis for the allocation of limited resources for economic development because, by doing so the outputs of supplying sectors in the region are also increasing, creating more direct, indirect and induced effects on the economy. These effects can be quantified by using the respective production, income and employment

multipliers as discussed in Chapter 7. On the other hand, sectors like distribution, professional business and other services, construction, oil products and chemicals, transport, utilities, quarrying and oil exploration and food products are in the top group when they are ranked in terms of forward linkages and coefficients of variation. This shows that these sectors sell a higher proportion of their outputs to the local processing sectors and these sales are distributed more evenly among the buying sectors. Brewing, soft drinks and spirits, metal and metal products and electrical engineering with their low level of intersectoral dependence appear in the bottom of the ranked sectoral hierarchy.

An attempt has so far been made to identify key sectors of the Tayside economy purely in a technological manner by using the methodology practiced by Rasmussen, and by Hirschman and also by using the adjustments made to this methodology by Hazari. In regional planning it may also be important to identify such sectors by defining them in accordance with planners' preference functions, and given technological structure. The preference functions of planners may be maximisations of employment, regional income, or import substitution, export promotion etc. The main difference between these two alternative methods is that the first identifies key sectors through the linkage analysis whereas the latter defines key sectors according to the preference functions of planners. In this latter method it is considered that the planners' objective function is described by the final demand vector, where the planners' fixed targets that have to be achieved during the planning period are expressed. The final demand vector and the elements of the inverse of (1-A) are denoted by F and R_{ij} respectively. If the planners' target is to increase the final demand of say sector one, by one unit, the levels of output required to meet a unit increase in final demand can be computed as follows:

$$(1 - A^{Ty})^{-1} F = \underset{m \times m}{\begin{bmatrix} R_{11} & R_{12} & \cdots & R_{1m} \\ R_{21} & R_{22} & \cdots & R_{2m} \\ \cdot & & & \\ \cdot & & & \\ \cdot & & & \\ R_{m1} & R_{m2} & \cdots & R_{mm} \end{bmatrix}} \underset{m \times 1}{\begin{bmatrix} F_1 \\ 0 \\ \cdot \\ \cdot \\ \cdot \\ 0 \end{bmatrix}} = \begin{bmatrix} R_{11} & F_1 \\ R_{21} & F_1 \\ \cdot & \cdot \\ \cdot & \cdot \\ \cdot & \cdot \\ R_{m1} & F_1 \end{bmatrix}$$

This can be illustrated as follows:

$$Z_j = \sum_{i=1}^{m} R_{ij} \cdot F_j$$

In the inverse matrix each row can be interpreted as the increase in the gross output levels of the sector i to meet a unit increase in the final demand for the products of all the sectors. This can be computed as follows:

$$Z_i = \sum_{j=1}^{m} R_{ij} \cdot F_i$$

When both Z_j and Z_i are higher relative to other sectors, these sectors are defined as key sectors.

It may be seen that the methodology of Hirschman and others in identifying key sectors through linkages has been unable to provide planners with a more realistic yardstick in formulating policies and strategies for the Tayside Region. This is because of the existence of a low level of forward linkages. Chapter 3 shows that Tayside has undergone some structural changes during the last decade mainly by adopting an outward looking industrial strategy. Chapter 7 also shows the importance of exports in generating regional income. These factors suggest that the industrial strategy in Tayside has been and still is mainly concentrated on export promotion. In an economy which gives priorities to this kind of strategy, the key sector concept through backward and forward linkages can hardly provide any useful criterion for policy formulation. Therefore, the key sector concept needs to be flexible according to the economic structure which differs from region to region and the objectives of the structure plans and local plans. In this regard, sectors which have a higher level of backward linkages which exceed unity with a lower level of V_j can be considered as the key sectors of the Tayside Region. Secondly, the key sectors so obtained may be used in co-operation with the key sectors derived by using planners' objective functions, and this will help the formulation of more realistic policies and proposals required for the Tayside economic development.

SECTORAL INTER-DEPENDENCE AND IMPORT SUBSTITUTION

Analysis of sectoral inter-dependence provides much useful information in deriving strategies. For example, having examined the sectors which have a higher level of inter-dependence and a low level of leakages from the regions, those sectors can be proposed for further expansion programmes in the region. Such proposals help to increase regional income, regional employment and output through the higher level of multiplier effects. On the other hand, it may be necessary for the planners to derive strategies to pursue sectors which produce competitive imported goods when there are sectors which have a low level of inter-dependence and a high level of leakages, and specifically when they affect the limited foreign exchange resources in the regions. As was also suggested in Chapter 7, there may be some attention given in regional planning to alternative patterns of import substitutions.

Import substitution suggests a shift in the source of supply of a commodity from import to domestic production. This process has its impact on the production levels and import levels of the particular sector in question and also of many other sectors in the region. This is because the dependence of a sector on import is not totally reflected in the imports of that sector itself. Any sector in Tayside may use some domestically produced inputs and these domestic suppliers may have some import content too. The total import content, therefore, incorporates these direct and indirect import requirements. Thus, in appraising any industrial development programme it is necessary to identify its impact upon the import dependence of the economy. This can be done by evaluating the foreign exchange implications of the proposed industrial investment programmes.

A modified input-output transaction table facilitates the evaluation of such foreign exchange implications. The first stage of the preparation of this table is the construction of an import matrix so that a separation between imported and domestically produced inputs in each cell can be made in the original transaction table.[15] The imports then need to be further classified in each cell into competitive and non-competitive elements. The competitive imports can be aggregated horizontally and they can be expressed as a column vector in final demand. This column needs to be deducted from the remaining final demand columns. The non-competitive imports are aggregated vertically and they can be presented as a row of primary inputs. Thus, each cell of the structural matrix represents both domestically produced input and competitive imports. This matrix is then used to derive a matrix of direct coefficients and an inverse matrix. The new inverse matrix helps the planners to experiment with and analyse the direct and indirect consequences of alternative assumptions in relation to import substitution.

8.2.3. EVALUATION OF THE IMPACT OF POLICIES AND STRATEGIES

According to the Tayside Structure Plans 1979 and 1980, it may be seen that the planners have well identified the constraints of resources. The Structure Plan 1979, for example, pointed out that "the strategy contained in the Consultative Draft is to accommodate the population likely to arise from current trends and a balance of inward and outward migration by providing the maximum possible choice of residential and industrial location within the framework of severely limited financial resources and the existing development constraints affecting many towns in the regions."[16] As pointed out by these plans the implementation

---

15. The Tayside Input-Output Table for 1979 does not help to form this kind of separation because the structural matrix provides only trade relationships within the region.

16. Tayside Regional Council. Tayside Structure Plan 1979, p51.

of strategies primarily depends on the amount of finance available.

However, although the constraints on development are recognised and well analysed by planners, there is no evidence of evaluation of the outcome of policies and proposals once they are formed. The most common result is that some investment programmes may produce a series of undesirable effects on the economy. This problem can be avoided by assessing the direct and indirect repercussions of policies and strategies before they are implemented. The Tayside input-output tables provide planners with some guidelines in evaluating the impact of their proposed strategies.

IMPACT ANALYSIS

Direct, indirect and induced effects of any change in final demand can be considered as economic impacts on the region's economy. Multipliers derived from the input-output inverse matrices for the Tayside Region facilitate the measurement of the impact when the change in final demand occurs for the existing sectors in the Tayside input-output tables. As was examined in Chapter 7, impact analysis can be carried out by computing type one and two output, income and employment multipliers, given the change in final demand of the sector in question.

However, planners may need to examine the impact of the introduction of new industry in the region. In order to highlight the results of this analysis it is important to isolate this new industry in the input-output matrices as a separate sector. In this situation a new row and column can be added to the existing table T.1. The new sector needs estimates of the projected output, sales to the final demand, and its purchase pattern. Given these estimates, a new direct coefficients matrix and inverse matrix can be obtained and the impact of new industry upon the region's output, income and employment can be measured as discussed in section 7.7 of Chapter 7.

Also, some changes in final demand may occur not in the sectors individually as discussed before, but in the economy as a whole. For example, changes in national government policies and strategies, changes in the external value of currency etc., may result in changes in final demand of many sectors in Tayside. Regional planners may need to examine the total impact of these changes on the Tayside economy in order to make necessary adjustments to their regional policies. In this case multiplier analysis alone is inappropriate and therefore an evaluation of the impact of such exogeneous changes on the regional economy needs to be made using input-output inverse matrices. New values resulting from changes in say, export income can be adjusted in the final demand vector of the table 7.1. The corresponding gross outputs, i.e. vector X^* can then be obtained as follows:

$$X^* = (1-A^{Ty})^{-1} \quad Y^*$$

where Y^* denotes new values of the final demand vector. The necessary adjustments for the inter-sectoral trade flows can be computed by substituting values of the vector X^* into the following equation.

$$X^*_{ij} = a_{ij} \; X^*$$

where X^*_{ij} denotes inter-sectoral trade flows and a_{ij} show the Tayside domestic flow coefficients.

The impact analysis based on Tayside input-output tables depends mainly on two assumptions. First, it is assumed there is an unlimited labour pool in the economy. If the region had full employment, the introduction of new industry might cause a shift of labour from one sector to another. On the other hand, even if the region had a large unutilised labour force there might be a shortage of the supply of necessary skilled labour. Therefore, this assumption may create some practical problems in the application of the model. Second, it is assumed that the new industry should be associated with changes in the final demand of the relevant sector. For example, when the new industry is a part of the region's import substitution strategy, a larger proportion of this industry's output may be directed to fulfilling the requirements of regional processing sectors and leave only a small proportion for the final demand. This will be more clearly visible when households are treated as a processing sector. Thus, in such cases, the second assumption may not be practicable. One way of coping with this problem is to adjust the changes, in direct input coefficients, (a^*_{ij}), and then the new final demand vector can be obtained as follows.

$$X^* \, (1-A^{Ty*}) = Y^*$$

where Y^* shows the new final demand vector. The output, income and employment multipliers can be obtained by inverting the adjusted direct input coefficients matrix.

The impact analysis itself cannot provide a satisfactory criterion to guide the planners in evaluating their strategies. This is because, as was seen in Chapter 7.7, the Sectors with a high degree of multipliers are not necessarily ones that should be encouraged in any expansion programmes. Therefore, the impact analysis cannot be used mechanically in evaluating alternative investment opportunites, for example, but they can provide useful guidelines in identifying activities which have large direct, indirect and induced effects.

The main problem concerning the use of Tayside input-output tables in the region's economic planning is the impracticability of some of the assumption of this model, specifically the stability of domestic flow coefficients, during the planning period. This is particularly the case in the process of projections of regional output, final demand and regional employment. These tables may provide satisfactory guidelines for the early years of the construction. However, when regional plans involve long periods the analytical value of this analysis tends to decrease because of changes in domestic flow coefficients, due to changes in technology and changes in regional industrial strategies. Therefore, in order to cope with this difficulty, the input coefficients need to be updated regularly by inserting more recent data into the intermediate matrix of the Tayside input-output tables.

CHAPTER 9

COMPARISON OF RESULTS: SURVEY-BASED AND NON-SURVEY INPUT-OUTPUT TABLES FOR TAYSIDE 1979

As was discussed in Chapter 4, non-survey input-output tables can provide a useful alternative for Regional planners in terms of saving time and cost. However, the planning requirements would be met through non-survey input-output models only if these tables could produce an analytical framework with a reasonable degree of accuracy when compared with results of survey-based input-output tables. The objective of this chapter is, therefore, to test this proposition, i.e. whether the non-survey tables of Tayside can produce acceptable results for regional planning compared to the results of Regional survey-based input-output tables.

The survey-based input-output tables of Tayside were obtained by using a partial survey together with some Scottish input coefficients. The non-survey Tayside input-output table was computed by using Simple Location Quotient (SLQ), technique, and this table is given in Table 4.1. The rationale for using SLQ technique among other non-survey techniques was analysed in Chapter 4. The methodology followed in constructing non-survey input-output tables based on SLQ was also given in Chapter 4. The results of survey-based and non-survey input-output tables will be examined in the succeeding sections with reference to CHI Square test, import coefficients, sectoral multipliers and linkage analysis.

9.1 CHI SQUARE TEST

This test measures the relative differences between two sets of coefficients. The closeness of χ^2 values to zero indicates the degree of goodness fit. χ^2 values[1] for the Tayside non-survey and survey-based input-output tables were computed for the two tables, (Tables 7.2 and 4.1) as a whole, and for the individual sectors. It is seen that the differences between the test results for overall tables are so small as to be almost negligible. However, as shown in Table 9.2., a detailed comparison by columns and rows shows some degree of difference. Each of the coefficients in columns and rows of the survey-based and non survey input-output tables was compared by using χ^2 test.

The χ^2 test shows that differences of input coefficients of the sectors like agriculture, fishing, brewing, soft drinks and other spirits, metal and metal goods, instrumental engineering engineering, clothing, building materials, paper, printing and publishing, rubber and plastic products, utilities, transport and distribution, are indicated by zero values. This suggests, from the view point of production techniques, that the input coefficients of these sectors in the non-survey tables are similar to those of the survey-based tables. For the rest of the eleven sectors, there are some differences in input co-efficients. This shows that the production techniques in these eleven sectors in Scotland and Tayside are different and by using the non-survey input coefficients for the Regional planning

---

1. χ^2 values were computed as follows:

$$\chi^2 = \sum_i \sum_j \frac{(\hat{A}^{Ty}_{ij} - A^{Ty}_{ij})^2}{A^{Ty}_{ij}}$$

Where $\hat{A}^{Ty}_{ij}$ denote non-survey domestic flow coefficients and A^{Ty}_{ij} are survey-based domestic flow coefficients.

Table 9 - 2

Results of the CHI SQUARE Test

	Sectors	Input side x^2 values	Output side x^2 values
1.	Agriculture	0.0	0.0
2.	Fishing	0.0	0.0
3.	Quarrying & Oil Exploration	0.45966	33.527
4.	Food Products	1.8089	0.0
5.	Brewing, Soft Drinks & Spirits	0.0	0.0348
6.	Oil Products & Chemicals	0.0	0.9245
7.	Metal & Metal Goods	0.0	0.0
8.	Mechanical Engineering	6.2416	0.0
9.	Instrument Engineering	0.0	0.2939
10.	Electrical Engineering	0.0	35.167
11.	Shipbuilding & Marine Eng.	0.7908	0.0224
12.	Textiles	10.02707	3.075
13.	Clothing	0.0	0.0
14.	Building Materials	0.0	0.0
15.	Timber Products	1.12737	0.0
16.	Paper, Printing & Publishing	0.0	5.951
17.	Rubber & Plastic Products	0.0	0.0
18.	Construction	3.07188	0.0
19.	Utilities	0.0	0.2315
20.	Transport	0.0	0.7779
21.	Communications	8.83005	0.4122
22.	Distribution	0.0	1.0448
23.	Finance Services	1.0043	1.6462
24.	Professional & Business and Other Services	0.5413	1.5677
25.	Local Government	1.07275	0.1993
26.	Households	0.0	3.2476

machinery, the analytical value of the input-output model will be distorted.

From the output side, which illustrates the product mix of individual sectors, the χ^2 test shows zero values for the sectors such as agriculture, fishing, food products, metal and metal goods, mechanical engineering, clothing, building materials, timber products, rubber and plastic products, and construction. This suggests, for such sectors, the pattern of sales distribution of the same sectors in Scotland can be applied for the Tayside input-output tables without adjustments. However, for the rest of the sectors which show considerable differences in sales distribution, specifically in electrical engineering, survey data need to be introduced into the Tayside input-output tables. Therefore, there may not be any difference in the two sets of tables as a whole; but the χ^2 test for individual sectors shows the need for more survey data for some sectors in order to use these input-output tables as an analytical tool.

9.2 IMPORT COEFFICIENTS

Import coefficients for the input-output tables show the regional dependency on imports, regional leakages and the degree of inter-sectoral dependence. Table 9.3. compares the import coefficients of survey-based and non-survey tables. The proportional differences[2] of import coefficients of each sector were also computed in order to examine any under-estimation or over-estimation. The values of

---

2. These values were obtained by subtracting survey based import coefficient from the non-survey one and dividing it by survey-based coefficients.

Table 9 - 3

Comparison of Import Coefficients : Survey-Based and Non-Survey Tayside Input-Output Tables

	Sectors	Survey-Based	Non-Survey	Proportional Difference
1.	Agriculture	0.116	0.0616	- 0.4689
2.	Fishing	0.33	0.0597	- 0.819
3.	Quarrying & Oil Exploration	0.24	0.0854	- 0.644
4.	Food Products	0.22	0.0491	- 0.7768
5.	Brewing, Soft Drinks & Spirits	0.57	0.0867	- 0.8478
6.	Oil Products & Chemicals	0.74	0.1465	- 0.802
7.	Metal & Metal Products	0.704	0.2099	- 0.7018
8.	Mechanical Engineering	0.23	0.2064	- 0.1026
9.	Instrument Engineering	0.275	0.09	- 0.6727
10.	Electrical Engineering	0.484	0.1114	- 0.7698
11.	Shipbuilding & Marine Eng.	0.271	0.2097	- 0.226
12.	Textiles	0.35	0.0416	- 0.8811
13.	Clothing	0.16	0.0153	- 0.9043
14.	Building Materials	0.19	0.1199	- 0.3689
15.	Timber Products	0.48	0.03798	- 0.92
16.	Paper, Printing & Publishing	0.54	0.0517	- 0.904
17.	Rubber & Plastic Products	0.186	0.12688	- 0.3178
18.	Construction	0.283	0.1133	- 0.5996
19.	Utilities	0.043	0.0635	0.4767
20.	Transport	0.3	0.0569	- 0.81
21.	Communications	0.064	0.0144	- 0.775
22.	Distribution	0.56	0.0278	- 0.95
23.	Finance Services	0.079	0.0131	- 0.834
24.	Professional, Business & Other Services	0.025	0.0265	0.06
25.	Local Government	-	0.0267	-

proportional differences show that the non-survey tables are under-estimating the imports for almost all the sectors except utilities and professional, business and other services. If one considers the degree of accuracy in the value of differences which lie below 25%, the values for almost all the sectors fall beyond this limit. This implies that the non-survey input-output tables based on SLQ technique cannot provide reliable estimates for trade flows and trade coefficients for imports. The reason for this weakness lies in an assumption of SLQ technique, i.e., the maximization of local trade. This means when a commodity i is available in the region, sector j purchases all its input requirements of i from local produces. It is assumed that there is no cross-hauling which suggests that any sector can undertake only exports or imports; but not both.

The low level of imports show the low degree of regional leakages and high degree of sectoral inter-dependence. Thus, under-estimation of the import coefficients could mislead the decision making process specifically in suggesting policies for discouraging imports, and import substitution programmes in regional planning, and also in measuring their implications.

9.3 SECTORAL MULTIPLIERS

9.3.1. PRODUCTION MULTIPLIERS

One of the major applications of the input-output model in regional planning is in multiplier studies. Therefore, it is worthwhile to compare the closeness of multipliers computed from non-survey input-output tables to the survey-based results. For this comparison two inverse matrices were computed with and without households in the structural matrix. The household figures in Scottish

Input-Output tables were used in estimating households coefficients for the non-survey tables in Tayside.

A comparison of production multipliers; type one and two, computed for survey-based and non-survey input-output tables is shown in table 9.4. It indicates that the type one and two production multipliers are higher for almost all the sectors in the non-survey tables than those of the survey based tables. The values for proportional differences tabulated in table 9.6 suggest, generally, that non-survey tables over-estimate production multipliers. However, a detailed analysis reveals that type one production multipliers for service sectors in non-survey tables are closer to those of the survey based tables with a reasonable degree of accuracy, i.e. less than 25%. The type two production multipliers of non-survey tables show an over-estimation for all the sectors except professional, business and other services, and quarrying and oil exploration. This suggests that the non-survey tables cannot be used with reasonable accuracy in the estimation of production multipliers which can provide the planners with information on the effects of an increase in final demand on the level of sectoral output of the region.

9.3.2. INCOME MULTIPLIERS

Sectoral income multipliers, type one and two for the non-survey input-output tables were computed by using the methods discussed in Chapter 7. These multipliers are given in table 9.5. The differences between the two sets of multipliers are of significance specifically for the sectors like quarrying and oil exploration, food products, textiles, agriculture, electrical engineering and clothing. Table

Table 9 - 4

Comparison of Production Multipliers : Survey Based and Non-Survey Input-Output Tables, 1979, for Tayside.

	Sectors	Survey-based		Non-Survey	
		Type One	Type Two	Type One	Type Two
1.	Agriculture	1.5306	3.1035	1.9643	3.4322
2.	Fishing	1.4423	2.4327	1.4127	3.4352
3.	Quarrying & Oil Exploration	1.3142	2.556	1.4829	2.5991
4.	Food Products	1.6228	2.1092	2.3807	3.8361
5.	Brewing, Soft Drinks & Spirits	1.3603	1.6932	1.8394	3.1256
6.	Oil Products & Chemicals	1.1913	1.4463	1.859	2.983
7.	Metal & Metal Products	1.2028	1.5558	1.5789	3.0637
8.	Mechanical Engineering	1.4149	2.4036	1.5114	3.0796
9.	Instrument Engineering	1.4816	2.456	1.5616	3.3495
10.	Electrical Engineering	1.1705	1.7267	1.6731	3.1187
11.	Shipbuilding & Marine Eng.	1.338	2.2722	1.5436	3.3663
12.	Textiles	1.3843	2.3247	2.1347	3.9327
13.	Clothing	1.5069	2.6172	2.0802	4.0102
14.	Building Materials	1.412	2.4869	1.6114	3.365
15.	Timber Products	1.34	1.8022	2.2813	4.1928
16.	Paper, Printing & Publishing	1.2256	1.5809	1.8619	3.8001
17.	Rubber & Plastic Products	1.5005	2.3645	1.7646	3.3803
18.	Construction	1.6153	2.5764	1.8139	3.5237
19.	Utilities	1.4473	2.1075	1.4371	2.6528
20.	Transport	1.4482	2.1951	1.3483	3.5565
21.	Communications	1.0887	2.5804	1.2425	3.3419
22.	Distribution	1.4346	1.8094	1.2651	2.8584
23.	Finance Services	1.1132	2.6224	1.3573	3.1422
24.	Professional, Business & Other Services	1.1123	2.757	1.3132	2.6820
25.	Local Government	1.7198	3.2807	1.3766	4.1099

Table 9 - 5

Comparison of Income Multipliers : Survey Based and Non-Survey Input-Output Tables, 1979, for Tayside

	Sectors	Survey-based		Non-Survey	
		Type One	Type Two	Type One	Type Two
1.	Agriculture	1.3132	1.6721	2.154	3.296
2.	Fishing	1.4298	1.8214	1.291	1.975
3.	Quarrying & Oil Exploration	1.1726	1.4937	2.1107	3.043
4.	Food Products	2.2802	2.9045	3.7938	5.825
5.	Brewing, Soft Drinks & Spirits	2.0742	2.6423	2.5261	3.865
6.	Oil Products & Chemicals	2.202	2.8047	2.4863	3.8175
7.	Metal & Metal Products	1.379	1.7576	1.598	2.455
8.	Mechanical Engineering	1.3026	1.6593	1.4934	2.293
9.	Instrument Engineering	1.531	1.9499	1.47	2.2622
10.	Electrical Engineering	1.1598	1.4774	1.7909	2.75
11.	Shipbuilding & Marine Eng.	1.2559	1.5999	1.4458	2.22
12.	Textiles	1.2721	1.6205	2.1719	3.334
13.	Clothing	1.3153	1.6745	1.9786	3.038
14.	Building Materials	1.3963	1.7786	1.5398	2.364
15.	Timber Products	1.8922	2.4102	2.4627	3.781
16.	Paper, Printing & Publishing	1.7066	2.1739	1.8561	2.85
17.	Rubber & Plastic Products	1.3474	1.7164	1.6473	2.529
18.	Construction	1.53	1.9489	1.8162	2.7887
19.	Utilities	1.924	2.4487	1.4626	2.245
20.	Transport	1.582	2.0155	1.2374	1.899
21.	Communications	1.036	1.3202	1.1348	1.7362
22.	Distribution	1.6578	2.1119	1.2372	1.899
23.	Finance Services	1.0769	1.3725	1.346	2.066
24.	Professional, Business & Other Services	1.0523	1.3405	1.3187	2.0299
25.	Local Government	1.592	2.0275	1.148	1.7627

9.6 shows that the non-survey tables over-estimate the income multipliers except for local government, distribution, transport and utilities. For these sectors type one and two income multipliers of non-survey tables are nearer to the survey results when compared to the rest of the sectors. The proportional differences for the rest are more than 80%. This means that the non-survey tables are not able to produce income multipliers within the acceptable limits. Thus, the role of non-survey tables in the derivation of multipliers for impact analysis in planning is limited.

9.4 LINKAGE ANALYSIS

Backward and forward linkages were computed for the non-survey tables by using Hirschman's criterion which was discussed in Chapter 8. In this analysis, households were excluded from the structural matrix of the input-output tables in order to examine the linkages among the primary, manufacturing, commerce and service sectors in the economy.

Table 9.7 shows that the backward and forward linkages produced by non-survey tables are not comparable to the survey results, except for the sectors like instrument engineering and construction. Both kind of linkages computed from non-survey tables are close to the survey results only for these last two sectors. For the sectors like communications, finance services, and local government, non-survey tables underestimate their linkage relationships. Also, for the rest of the sectors, these linkages are over-estimated by the non-survey tables. This linkage analysis therefore, suggests, as a whole, that the non-survey tables are unable to provide planners with

Table 9 - 6

Production and Income Multipliers : Comparison of Survey-Based and Non-Survey Input-Output Tables 1979 for Tayside

	Sectors	Proportional Differences			
		Production Multipliers		Income Multipliers	
		Type One	Type Two	Type One	Type Two
1.	Agriculture	0.2833	0.1059	0.64	0.9712
2.	Fishing	- 0.02	0.412	- 0.096	0.0842
3.	Quarrying & Oil Exploration	0.128	0.0168	0.8	1.0372
4.	Food Products	0.467	0.8187	0.6638	1.0055
5.	Brewing, Soft Drinks & Other Spirits	0.3522	0.8497	0.2178	0.4627
6.	Oil Products & Chemicals	0.5604	1.062	0.129	0.3611
7.	Metal & Metal Goods	0.3126	0.9692	0.1588	0.3967
8.	Mechanical Engineering	0.0682	0.2812	0.1464	0.3819
9.	Instrument Engineering	0.0539	0.3638	- 0.039	0.16
10.	Electrical Engineering	0.4293	0.8061	0.544	0.861
11.	Shipbuilding & Marine Eng.	0.1536	0.4815	0.15	0.3875
12.	Textiles	0.542	0.6917	0.707	1.057
13.	Clothing	0.3804	0.5322	0.504	0.814
14.	Building Materials	0.1412	0.353	0.1027	0.329
15.	Timber Products	0.702	1.3264	0.301	0.5687
16.	Paper, Printing & Publishing	0.5191	1.403	0.087	0.311
17.	Rubber & Plastic Products	0.176	0.4296	0.2225	0.473
18.	Construction	0.1229	0.3676	0.187	0.43
19.	Utilities	- 0.007	0.2587	- 0.239	- 0.083
20.	Transport	- 0.067	0.62	- 0.2178	- 0.0578
21.	Communications	0.1412	0.2951	0.0953	0.3151
22.	Distribution	- 0.118	0.579	- 0.253	- 0.1
23.	Finance Services	0.219	0.1982	0.2498	0.5053
24.	Professional, Business & Other Services	0.1806	- 0.025	0.2531	0.5658
25.	Local Government	- 0.199	0.2527	- 0.279	- 0.136

Table 9 - 7

Comparison of Backward and Forward Linkages based on Hirschman's Criterion : Survey-based and Non-survey Tayside Input-Output Tables

	Sectors	Survey-Based		Non-Survey	
		Backward	Forward	Backward	Forward
1.	Agriculture	37.7	50	52	87
2.	Fishing	32.9	26	26	3.9
3.	Quarrying & Oil Exploration	23	33	33	49
4.	Food Products	44.5	9.6	71	32.5
5.	Brewing, Soft Drinks & Other Spirits	26.9	7.8	51	9.8
6.	Oil Products & Chemicals	16	17.7	53	73
7.	Metal & Metal Products	15	9.4	38	51
8.	Mechanical Engineering	30.4	11	33	35.6
9.	Instrument Engineering	37	10.8	35	9
10.	Electrical Engineering	12.5	4.4	42	34.1
11.	Shipbuilding & Marine Eng.	26	12	35	11.6
12.	Textiles	28	8.8	59	89.3
13.	Clothing	35.6	2.3	54	0.8
14.	Building Materials	30.9	53	39	15
15.	Timber Products	25.7	21	63	52.5
16.	Paper, Printing & Publishing	17.1	9.4	49	53
17.	Rubber & Plastic Products	38.5	21	43	24.6
18.	Construction	40.2	40.9	46	42.6
19.	Utilities	33.8	53.8	28	29.8
20.	Transport	31.5	48.4	24	54
21.	Communications	6	60.3	15	15
22.	Distribution	30.8	42.6	18	51
23.	Finance Services	9	81.5	26	49.6
24.	Professional, Business & Other Services	8	30.9	19	69.1
25.	Local Government	52	6.1	27	18.2

useful information on the degree of regional inter-sectoral dependence, and on the selection of key sectors of the economy.

The χ^2 test shows that there are no significant differences between the domestic flow coefficient of survey-based and non-survey input-output tables for the Tayside Region. However, further analysis, such as import coefficients, multipliers and linkages suggest that the non-survey tables are unable to produce an analytical framework which is comparable to the survey-based one, with reasonable accuracy. The differences between the survey-based and non-survey tables imply that the product mix and technology between Scotland and Tayside are different and therefore it is not justifiable to use non-survey tables for planning purposes. The survey-based input-output tables are therefore more acceptable for the needs of Tayside Regional planning although the cost and time factors involved in producing these tables are higher than the non-survey tables.

CHAPTER 10

CONCLUSIONS

This study has presented survey-based input-output tables for Tayside, a descriptive and empirical analysis of the structure of the Tayside economy and an evaluation of the results with reference to planning for the Tayside Region. Some important findings have emerged from this study. Some of them are of particular value to Tayside planners and researchers and some can be of use for other regional input-output studies. These findings are summarised in this section.

Some important characteristics of the structure of the Tayside economy can be highlighted from the descriptive analysis based on secondary data. As revealed by the Location Quotients, computed for both the main order and the minimum order list headings of SIC, it is suggested that 22 industries (see Chapter 3) which have Location Quotients greater than one, have specialised locations in Tayside. These industries could be regarded as the leading sectors of the Tayside economy. This analysis also suggested that Tayside, between 1971 and 1978, was in the forefront in Scotland in terms of having specialised not only in traditional industries such as jute, the weaving of cotton and fibre, etc, but also in terms of most of the new growth industries such as chemicals and allied industries, scientific instruments, electric machinery and other electronic goods.

However, Tayside has experienced a considerable degree of structural change since the 1970s. Chapter 3 shows, that the manufacturing and primary products sectors were contracting in terms of employment between 1971 and 1978. One of the most significant features of the Tayside economy during this period was that the service sectors expanded continuously. Also, the Tayside economy was unable to create sufficient employment for its active workforce between 1975 and 1979. These structural changes have given rise to various problems, witnessed by a distorted labour market associated with the high level of unemployment, a high level of outward migration and a low level of household earnings. These factors suggest a declining demand for goods and services in the region which led to a further increase in unemployment and consequently a reduction in the purchasing power of households. Therefore, in deriving policies for the future economic development, there is an urgent need to give priority to overcome these problems.

Tayside has responded to these problems, to a certain extent, by bringing about two major structural changes in the economy, namely diversification and the attraction of new industries. However, sufficient statistics were not available for testing whether these structural changes have caused any great improvement to the Tayside economy.

Previous work on simulation techniques has been analysed in order to exploit a suitable technique for balancing the Tayside survey-based input-output tables, and also for testing the hypothesis as to whether the non-survey techniques are able to aid the construction of input-output tables for the needs of regional planners. It is seen that when there are a number of planning strategies to be assessed in a short period of time, the most acceptable choice among the non-survey techniques examined in Chapter 4 is the SLQ technique. However, because of differences in regional trade relationships, variations in production techniques and product mixes, a set of conclusions on a particular simulation technique derived from one case study may not be compatible with conclusions derived from another.

The main method of primary data collection for the present study was the postal survey. The work on this survey suggests that it is extremely difficult for an individual academic researcher to develop a satisfactory primary data base disaggregating primary, manufacturing, trade and service sectors in a fairly large region such as Tayside. Given the constraints of resources of time and finance, the most desirable way to obtain a primary data base for a regional input-output study is the postal survey. However, attention needs to be paid to careful design of covering letters and to design reasonably simple questionnaires. The information sacrificed by designing simplified questionnaires may be supplemented by published company accounts, local literature, and discussions with local businessmen, regional planning departments, and other local institutions. The ideals of sampling are hard to follow with this kind of study because the population of establishments is so discrete and therefore it is suggested that prime consideration should be given when sampling is done to the objectives of the study and to the particular characteristics of the local economy. It is also suggested that the sector classification and aggregation for a regional input-output study should be given a great deal of attention since these two variables significantly affect the final results of the study.

A balancing technique named ARAS was derived by introducing modifications to the RAS method. This technique is able to preserve the signs of the Leontief inverse matrix apart from its other advantages. Therefore, the ARAS method was used in balancing the Tayside survey-based input-output tables and these tables are able to provide a meaningful analytical framework through the inverse matrices. It is also possible to use this technique in the balancing of future regional input-output tables which use survey data together with national coefficients.

The structure of the Tayside economy was analysed in Chapter 7 by using the Tayside survey-based input-output tables. It shows that the GRP of Tayside for 1979 was £2866 per head. This indicates an increase of 26% when it is compared with the GRP for 1977. The analysis of sectoral contributions shows that food products, oil products and chemicals, printing and publishing, and distribution have made the highest contribution together, 48% to the Region's production. The engineering sectors contributed 14.5% while the traditional industries such as shipbuilding, textiles, and metal products generated 5.5% to the Regional gross production.

The total values of the exports and imports of Tayside in 1979 were 38% and 34% of gross outputs respectively. This highlights one of the Region's main characteristics, ie, its openness to foreign trade. The degree of sectoral interdependence revealed by the Tayside input-output accounts is not significant. These accounts show a low level of inter-sectoral relationships, a high level of dependency on imports, and a high level of export earnings.

Some important findings emerged from the multiplier analysis. The Tayside's income multipliers, for example, have mostly been affected by the direct income changes which are higher for the labour-intensive sectors such as services, and lower for the capital-intensive ones. The leakages from the service sectors are lower than the manufacturing sectors. The indirect effects created by increasing final demand are significantly lower for the service sectors than for the manufacturing sectors. It is difficult therefore to establish marked relationships between large direct income changes and large income multipliers.

The multiplier analysis also reveals that the use of this analysis in regional planning depends on the practicality of the assumptions, concerning linear and homogeneous consumption functions and linear employment production functions. The analysis in Chapter 7 suggests that these assumptions may limit the practical use of multipliers for the Tayside economy. Some modifications can be introduced to these assumptions in order to improve their applicability. The sectoral consumption functions can be derived for Tayside by using the Scottish consumption functions. This may be more rational and objective, since Tayside is considered to be a fair representative of the Scottish economy. Also, some flexibilities need to be introduced for the employment production functions for Tayside. The time series data on employment and output for past years can be made available for Tayside from confidential sources such as the disaggregated data of the census of production and the census of employment from relevant government departments in Scotland. This would allow the computation of employment/output ratios for each sector and these ratios can be used in the calculation of Tayside's employment multipliers.

The assessment in Chapter 8 suggests that the Tayside survey-based input-output tables can be incorporated into the formulation of plans, aims, objectives, policies and strategies and into the analysis of their implications. It is suggested that each analysis used in this assessment, such as the linkages and the selection of key sectors, should be applied in regional planning taking their own theoretical limitations into account.

It may be argued that the methodology of Hirschman and Others in identifying key sectors through linkages is unable to provide planners with realistic criteria for the formulation of policies and strategies for the Tayside Region. This is because of the existence of a low level of forward linkages. It was seen in Chapter 3 that Tayside has undergone some structural changes specifically during the 1970s partly by adopting an outward-looking industrial strategy. Chapter 7 depicts the importance of exports for generating Regional income. These factors suggests that the industrial strategy in Tayside has been and still is mainly concentrated on export promotion. For an economy which gives priority to this kind of strategy, the key sector concept based on both backward and forward linkages can hardly provide useful guidelines for policy formulation.

This suggests that the key-sector concept needs to be flexible in relation to economic structures which vary from region to region. In this regard, the sectors which have high levels of backward linkages, and which exceed unity with a high level of spread effects can be considered as the key sectors of the Tayside Region. The key sectors so obtained, may be used in planning, together with the key sectors derived by using the planners' objective functions such as employment maximisation, import substitution and export promotion. This will help in the formulation of the realistic policies and proposals required for Tayside's economic development. However, and in the cause of most efficient results, it can be suggested that the Tayside input-output tables should be updated regularly by inserting actual data into the structural matrix. Once the initial tables are constructed, the further updating of the tables is likely to be relatively inexpensive.

The testing of the hypothesis in Chapter 9 reveals that differences in trading patterns in Scotland and Tayside are significant, specifically when one examines the results of both tables, ie, the Tayside survey-based and the non-survey input-output tables disaggregated into sectors. Therefore it can be suggested that the use of the Scottish input coefficients for all the sectors in the Tayside input-output tables is erroneous. Although it is expensive and time consuming, survey-based input-output tables are more acceptable for the purposes of Tayside planners, since planning decisions based on more or less erroneous estimates may help to produce large negative impacts upon the economy.

SUGGESTIONS FOR FURTHER WORK

Further work drawing on lessons learnt from the present study may be suggested as follows:

First. The data base can be improved by focussing attention on the upper part of the first quadrant of the input-output table which represents the direct inputs and sales for the regional primary and manufacturing sectors. This is because the present study was able to cover satisfactorily the indirect inputs and sales for the construction, trade and service sectors of the Tayside Region, but not all those sectors in the upper part of this quadrant.

Second. The Tayside input-output tables for 1983 and subsequent years could be updated. This is because technology used in modern Tayside is changing rapidly and existing firms have been collapsing while new firms with new technology are appearing. Some firms in Tayside are diversifying into new growth sectors such as electronics, and North Sea-Oil related industries, or into the manufacture of multi products. This change in the structure of the Tayside economy implies the plausibility of constant production functions, and constant trade relationships, ie, one of the assumptions on which the present input-output model is based.

Third. A study of present development projects in Tayside and an analysis of their impact upon the Regional economy, based on the Tayside input-output tables, might be attempted.

Appendix 4.1

METHODOLOGY OF THE RAS

Given the national technical coefficients matrix, A_0 as the first approximation, survey data for intermediate outputs U_i, intermediate inputs V_j, and regional gross outputs X_i and the estimated regional technical coefficients matrix can be obtained as follows:

$$U_i^* = A_0 X_i \qquad (1)$$

where U_i^* is the vector of estimated regional intermediate outputs.

If the U_i is less than U_i^* then the i th row of A_0 is reduced by a factor which is applied evenly along the row. This factor is called R_i, row multiplier. In general terms R_i can be estimated as follows:

$$R_i = \frac{(U_i - U_i^*)}{\sum_{j=1}^{n} j} \qquad (2)$$

where $\sum_{j=1}^{n} j$ is the number of columns of the matrix. Hence A_2 can be obtained as follows;

$$A_i = R_i A_0 \qquad (3)$$

The same procedure can be applied for the column of the structural matrix, as follows.

$$S_j = \frac{(V_j - V_j^*)}{\sum_{i=1}^{n} i} \qquad (4)$$ Where $\sum_{i=1}^{n} i$ is the number of rows

The values so obtained for S_j can be adjusted to the columns of A_1 matrix, and the A_2 matrix can be estimated as follows:

$A_2 = S_j A_1$ 5. This means, by substituting equation 5 into equation 3,

$$A_2 = R_i A_0 S_j$$

This procedure needs to be repeated several times until the structural matrix is finally balanced.

Appendix 5.1.1

For official use only

1. GENERAL

1.1 Questionnaire No. 1

1.2 Please describe the nature of your Company/Organisation

a) An independent Company/Organisation with no branches. (Delete one) YES/NO 6

b) A Parent Company/Organisation with branches elsewhere (Delete one) YES/NO 7

c) A branch establishment of another Company/Organisation (Delete one) YES/NO 8

1.3 If the answer to 1.2.c is "Yes" please state the location of the Head Office

....

....

....

1.4 In what business(es)/services is your establishment engaged? (tick all that apply).

9

a) Manufacturing industrial products

b) Manufacturing consumer products

c) Distribution

d) Transportation

e) Professional services

f) Service establishment

g) Construction

h) Other(s) (please specify)

. . . .

. . . .

1.5 What is the financial year for which you are providing data? 19

....

2. Employment.

Note: In question No. 2.2. please include all wages and managerial and other salaries; overtime payments, bonuses and commissions, national insurance contributions, employees' pension schemes and other labour costs. i.e. cost of providing recreational facilities, social and welfare facilities etc.

2.1 About how many employees were there in your firm in the following categories?

	Male	Female
i Full-time employees		
ii Part-time employees		

23
27
31
35

2.2 Please state the total labour cost in the reference year 39

£.........

3. Purchase of raw materials/or goods for resale:-

Note: In 3.1 you are asked to provide information on the value of raw materials purchased in the reference year.

Please specify in column 7 the area, where you have bought raw materials by using the abbreviation 'T' for Tayside, 'ROS' for rest of Scotland, 'RUK' for rest of U.K. and 'ROW for rest of the world.

If you have bought a material or service from more than one area specified above, please indicate them seperately in columns 7 and 8.

Please give information in columns 3,4,5 and 6, only if transport cost is not included in the total cost in column 2.

3.1. Purchases of raw materials

	6	13	19	25	31	37	41	44	47
02	Items purchased	Total cost in the reference year £	Cost of transport				Origin of Purchases		For Official use only
			Road £	Rail £	Air £	Water £	Location	% of purchases	
	1	2	3	4	5	6	7	8	

3.2. Purchases of Business and Other Services

03

For Official Use Only	Name of Service	Total Cost	Origin of purchases			
			T %	ROS %	RUK %	ROW
1	2	3	4	5	6	7
	Gas					
	Electricity					
	Oil					
	Water					
	Accounting					
	Advertising					
	Banking					
	Insurance					
	Legal					
	Telephones					
	Postage					
	Printing					
	Rent					
	Others (Please specify below)					
	....					
	....					
	....					

4. Sales Analysis

Note: 4.1 In this section, you are asked to provide information, required for the analysis of interdependence of all Regional Sectors.

A part of your output of finished products may be used as inputs by other manufacturing industries, as well as by your own establishment, to produce other goods or services. Please indicate this information in Column 7.

Please specify in Column 8, the destination of sales by using the abbreviations of 'T' for Tayside, 'ROS' for rest of Scotland, 'RUK', for rest of U.K. and 'ROW' for rest of the world.

In Columns 3,4,5, and 6, please state the costs of transport only if these costs are not included in the total sales value.

4.1. Sales to Manufacturing Industries

6 13 19 25 31 37 41 44 47

04	Names of products or Services	Total Sales Value	Please state cost of transport for sales				Destination of Sales			For Official use only
		£	Road £	Rail £	Air £	Water £	Type of Industry	Location	% of Sales	
	1	2	3	4	5	6	7	8	9	

4.2. Other Sales

6 13 16 19 22 25 28 31 34 37 40 43

05	Names of products or Services	Total Value of Sales	Percentage of Sales Direct to:									For Official Use Only
			Household and retailers		Wholesalers		Government		Others		Export Market	
		£	In Tayside Region	Else-where	In Tayside Region	Else-where	Local govern-ment	Central govern-ment	In Tayside Region	Else-where		
	1	2	3	4	5	6	7	8	9	10	11	

5. Transport.

For Official use only

5.1 If you use your own road transport vehicles for all/part of your needs, please state the total cost to you, for the reference year.

a)	Cost of maintenance	£	6
b)	Fuel costs	£	12
c)	Labour costs	£	18

Note: If the data for 5.1 (c) is already included in the section 2 of this questionnaire, please indicate by stating "See section 2".

5.2 If you use external transport please state the total cost for the reference year.

a)	Total Cost of transport	£	24
b)	Approx. percentage of total cost paid to Tayside Contractors	%	30

6. Fixed Capital Formation:

6.1 Please state the cost of replacements or additions to your Company/Organisation in the reference year.

		Total Cost (£)	Origin of Purchases (Location) *
a)	Machinery & equipment	.....	....
b)	Office equip.	.....	....
c)	Vehicles	.....	....
d)	Building	.....	....
e)	Land	.....	....

* Please use the abbreviation 'T' for Tayside, 'ROS' for rest of Scotland, 'RUK' for rest of the U.K. and 'ROW' for the rest of the World.

For Official use only

6.2 What was the amount of depreciation in the reference year?

a)	Building	£	6
b)	Plant and machinery	£	13

7. Taxes and Subsidies

7.1 Please state the amount of taxes paid and subsidies received in the reference year.

		Amount	
a)	Indirect taxes paid	£	20
b)	Corporate taxes paid	£	27
c)	Subsidies received	£	34

8. Value of Stock

8.1 Please state the value of stock at the end of the reference year.

a)	Raw materials	£	41
b)	Finished products	£	48
c)	Work in Progress	£	55

Please add any comments or suggestions below.

Many thanks for your help.

Please return the Questionnaire as soon as possible in the enclosed stamped addressed envelope.

Mrs T.S.K. Athugalage

CONFIDENTIAL

Tayside Economic Survey

General guidelines for the questionnaire

The aim of this survey is to obtain data and information for the financial year 1979. If this is not possible please use the nearest available financial year. (Please see question 1.5 below).

"Tayside" in this survey refers to the area covered by burgh and county councils of Dundee, Perth, Angus and Arbroath.

Please include figures or information relevant only to your establishment. If you include data for other establishments operated by your organisation, please indicate their addresses, nature of work undertaken, number of employees and average turnover, at the end of this questionnaire.

Please use the following code to indicate the origin of purchases or destinations of sales in sections 3 and 4.

T - Tayside

ROS - Rest of Scotland

RUK - Rest of the U.K.

ROTW - Rest of the World

If it is impossible or difficult for you to provide accurate information for some parts of the questionnaire, leave them blank or use your best estimate. Please indicate with an "e" these figures which are estimates.

We should very much welcome your comments on any aspect of the questionnaire, or any other points you may wish to make. Space has been provided at the end, for this purpose.

1. GENERAL

For official use only

1.1 Questionnaire No. 1

1.2 Please describe the nature of your Company/Organisation

a) An independent Company/Organisation with no branches. (Delete one) YES/NO 6

b) A Parent Company/Organisation with branches elsewhere (Delete one) YES/NO 7

c) A branch establishment of another Company/Organisation (Delete one) YES/NO 8

1.3 If the answer to 1.2.c is "Yes" please state the location of the Head Office

....

....

....

1.4 In what business(es)/services is your establishment engaged? (tick all that apply). 9

a) Manufacturing industrial products

b) Manufacturing consumer products

c) Distribution

d) Transportation

e) Professional services

f) Service establishment

g) Construction

h) Other(s) (please specify)

....

....

1.5 What is the financial year for which you are providing data

....

19

2. Employment

Note : In question No. 2.2, please include all gross wages and managerial and other salaries; overtime payments, bunuses and commissions, employers'national insurance contributions, employers' pension schemes and other labour costs i.e., cost of providing recreational facilities, social and welfare facilities etc.

2.1 About how many employees were there in your firm in the following categories.

a. Full-time employees.

Male ...... 23 [| | |]

Female ...... 27 [| | |]

b. Part-time employees

Male ...... 31 [| | |]

Female ...... 35 [| | |]

2.2 Please state the total labour cost in reference year.

£ .... 39 [| | |]

3 Cost Analysis

3.1 Purchase of raw materials or goods for resale:-

In this section you are asked to provide information on purchases of raw materials or goods for resale during the reference year. This information is invaluable in analysing the extent to which local industries buy from and sell to each other.

Please include the value of goods or services purchased from sub-contractors and indicate with "S" these figures.

1 Items purchased	2 Total Cost £	3 Origin of purchases Location	 %	4 For office use only
e.g. Wool	60,000	T	70	
		ROTW	30	

3.2 Purchases of Business and other services

1 Name of the service	2 Total Cost £	3 Origin of Purchases	4 For Official use only
Gas			
Electricity			
Oil			
Rates			
Audit & Accounting			
Advertising			
Banking			
Insurance			
Legal			
Telephones			
Postage			
Printing			
Rent			
Laundry Services			
Catering			
Repairs & Maintenance			
Others (Please specify)			

3.4 If you use external transport please state the total annual cost for the reference year. £ ....

3.5 Please state the total capital expenditure incurred during the reference year.

	Total Cost £	Origin of Purchases
Machinery and equipment	....	....
Office equipment	....	....
Vehicles	....	....
Building	....	....
Land	....	....

3.6 What was the total amount of depreciation in the reference year?

Building £ ....

Plant and machinery £ ....

3.7 Please state the amount of taxes paid and subsidies received.

Taxes £ ....

Subsidies £ ....

3.8 Please state the value of stock at the end of the reference year.

£ ....

4. Income Analysis

In this section you are asked to provide information on the value of annual gross income. Please complete one or more of the following sections as appropriate.

4.1 Gross sales income of manufacturing industries.

1 Names of products	2 Annual Income £	3 Destination of sales Location	%	4 For Official use only
e.g. Computers	80,000	T	10	
		ROTW	90	

4.2 If you are in the construction industry, please state the value of contracts completed in the reference year.

£ ....

4.3 Please state the income received for services given to other organisations.

1 Name of Service	2 Total income £	3 Recipient of Service		4 For Office use only
		Type of Industry	Location	
e.g. Banking	150,000	Manufacturing	T	

4.4 Please state the sales income of goods bought and resold without processing, during the reference year.

£ ....

4.4.1 What percentage of above sales income was received from the customers in Tayside?

.... %

Please add any comments or suggestions below.

Many thanks for your help.
T.S.K. Athugalage (Mrs)

Appendix 5.1.3

CONFIDENTIAL

Tayside Economic Survey

General guidelines for the questionnaire

The aim of this survey is to obtain data and information for the financial year 1979. If this is not possible please use the nearest available financial year. (Please see question 1.3 below).

"Tayside" in this survey refers to the area covered by burgh and county councils of Dundee, Perth, Angus and Arbroath.

Please include figures or information relevant only to your establishment. If you include data for other establishments operated by your organisation, please indicate their addresses, nature of work undertaken, number of employees and average turnover, at the end of this questionnaire.

Please use the following code to indicate the origin of purchases or destinations of sales in sections 3 and 4.

T - Tayside

ROS - Rest of Scotland

RUK - Rest of the U.K.

ROTW - Rest of the World

If it is impossible or difficult for you to provide accurate information for some parts of the questionnaire, leave them blank or use your best estimate. Please indicate with an "e" these figures which are estimates.

We should very much welcome your comments on any aspect of the questionnaire, or any other points you may wish to make. Space has been provided at the end, for this purpose.

1. GENERAL

1.1 Questionnaire No. ....

1.2 Please describe the main activity of your business.

....

....

....

1.3 What is the financial year for which you are providing data?

....

2. EMPLOYMENT

2.1 Approximately how many employees were there in your firm in the reference year?

	At beginning of Year	At end of Year
(a) Full-time employees	....	....
(b) Part-time employees	....	....

2.2 Please state the total labour cost in the reference year. (Include all gross wages and managerial and other salaries, overtime payments, bonuses and commissions, employers' national insurance contributions etc., but before deduction for tax and other payments).

£ ....

3. COST ANALYSIS

3.1 What is the total cost of buying raw materials in the reference year?

£ ....

3.1.1 Please give an estimate of the value of raw materials purchased from the Tayside Region.

........%

3.2 What is the total operating cost in the reference year? (Include the cost of gas, electricity, oil, rates, audit and accounting, advertising, banking, insurance, legal, telephone, postage, printing etc.)

£ ....

3.3 What is the value of work done for you by sub-contractors?

£ ....

3.4 If you use external transport, please state the total annual cost for the reference year.

£ ....

3.5 What was the total amount of depreciation in the reference year?

£ ....

3.6 Please state the value of stock at beginning and end of the reference year.

Value at beginning of year £ ....

Value at end of year £ ....

4. INCOME ANALYSIS

Please answer one or more of the following questions as appropriate.

4.1 What is the gross sales income of the reference year?

£ ....

4.1.1 What percentage of above income was received from the customers in Tayside?

......%

4.2 If you are in the construction industry please state the value of contracts completed in the reference year.

£ ....

4.2.2 What percentage of above income was received from the customers in Tayside?

......%

4.3 Please state the income received for services given to other organisations.

Name of Service	Total Income £
....	....
....	....
....	....
....	....

4.3.1 What percentage of above income was received from customers in the Tayside Region?

......%

4.4 Please state the sales income of goods bought and resold without processing.

£ ....

Please add any comments or suggestions below.

Many thanks for your help.
T.S.K. Athugalage (Mrs)

1. GENERAL

1.1 Questionnaire No.

1.2 Please describe the main distributing/retailing items (e.g. electrical goods, machinery spare parts etc.)

....

....

....

1.3 What is the financial year for which you are providing data?

....

2. EMPLOYMENT

2.1 About how many employees were there in your business in the reference year?

	At beginning of Year	At end of Year
(a) Full-time employees	....	....
(b) Part-time employees	....	....

2.2 Please state the total labour cost in the reference year. (Include all gross wages and managerial and other salaries, overtime payments, bonuses and commissions, employers' national insurance contributions etc., but before deductions for tax and other payments).

£ ....

3. COST ANALYSIS

3.1 What is the cost of goods purchased for resale?

£ ....

3.1.1 What percentage of this value was spent for the goods purchased from the Tayside Region?

......%

3.2 Please state the operating expenditure during the reference year. (Include the cost of electricity, gas, rates, rents, advertising, printing etc.)

£ ....

3.3 What is the cost of transport in the reference year?

£ ....

3.4 Please state the value of stock at beginning and end of the reference year.

Value at beginning of year £ ....

Value at end of year £ ....

3.5 What is the value of other expenditure which cannot be specified above?

£ ....

4. <u>INCOME ANALYSIS</u>

4.1 Please state the sales income of goods bought and resold without processing.

£ ....

4.1.1 What percentage of above sales income was received from the customers in Tayside.

......%

Please add any comments or suggestions below.

Many thanks for your help.
T.S.K. Athugalage (Mrs)

BIBILIOGRAPHY

A. GOVERNMENT PUBLICATIONS

1. Central Statistical Office — ANNUAL ABSTRACTS OF STATISTICS From 1978 to 1982, HMSO.

2. Central Statistical Office — "Preliminary Estimates of Regional Gross Domestic Product", ECONOMIC TRENDS, No. 241, HMSO, 1973.

3. Central Statistical Office — REGIONAL TRENDS For 1981 and 1982, HMSO.

4. Department of Employment — "New Estimates of Employment on a Continuous Basis, Employees and Self-Employed 1961 - 1974", DEPARTMENT OF EMPLOYMENT GAZETTE Vol. LXXXIV, No. 12, 1344 - 1349.

5. Department of Industry and Business Statistics Office INPUT-OUTPUT TABLES FOR THE UNITED KINGDOM 1970, HMSO, 1974.

6. Department of Industry and Business Statistics Office INPUT-OUTPUT TABLES FOR THE UNITED KINGDOM 1972, HMSO, 1976.

7. Department of Scotland Agriculture & Fisheries ECONOMIC REPORT ON SCOTTISH AGRICULTURE 1980.

8. Forestry Commission — 60th ANNUAL REPORT AND ACCOUNTS 1979/80.

9. HMSO — FISHERIES OF SCOTLAND : REPORT FOR 1980.

10. HMSO — STANDARD INDUSTRIAL CLASSIFICATION 1968.

11. RATING REVIEWS 34th Year of Issue June, 1979.

12. Registrar General for Scotland ANNUAL REPORTS From 1975 to 1982, HMSO.

13. Registrar General for Scotland CENSUS OF POPULATION : TAYSIDE REGIONAL COUNCIL 1981, Vols. 1 and 2, 1982.

14. Scottish Office — SCOTTISH ABSTRACTS OF STATISTICS From 1975 to 1982, HMSO.

B. OTHER OFFICIAL PUBLICATIONS

1. Scottish Development Agency ANNUAL REPORTS 1979 AND 1980.
2. Scottish Tourist Board ANNUAL REPORT 1979.
3. Tayside Regional Council TAYSIDE STRUCTURE PLAN (DRAFT) 1978.
4. Tayside Regional Council TAYSIDE STRUCTURE PLANS FOR 1979 AND 1980.
5. Tayside Regional Council TAYSIDE STRUCTURE PLAN : REPORT AND SURVEY 1980.
6. Tayside Region Industrial Office TAYSIDE ENGINEERING REGISTER 1981.
7. Tayside Region Industrial Office TAYSIDE MANUFACTURERS REGISTER 1981.
8. Tayside Regional Council QUARTERLY ECONOMIC REVIEWS.

C. NEWSPAPERS AND JOURNALS

1. Courier and Advertiser, Dundee, Tayside
2. Annals of Regional Science
3. Agricultural Economics Research
4. America's Economic Reviews
5. Econometrica
6. Environment and Planning
7. Journal of Regional Science
8. Oxford Economic Papers
9. Oxford Bulletin of Economics and Statistics
10. Papers and Proceedings of the Regional Science Association
11. Public Opinion Quarterly
12. Regional Studies
13. The Reviews of Economics and Statistics
14. Review of Regional Studies
15. Dundee and Tayside Chamber of Commerce and Industry, Dundee and Tayside Journals

D. ARTICLES IN LEARNED JOURNALS

1. Archibald, G.C."Regional Multiplier Effects in the U.K.", OXFORD ECONOMIC PAPERS, Vol. 19, 1967.

2. Allen, R.I.G."Some Experiments with RAS Method of Updating Input-Output Coefficients", OXFORD BULLETIN OF ECONOMICS AND STATISTICS, Vol.36,No.5,1974,215-218.

3. Blake,C. and McDowall,S."A Local Input-Output Table", SCOTTISH JOURNAL OF POLITICAL ECONOMY, Vol.14,1967.

4. Boster, R.S. and Martin, W.E."The Value of Primary Versus Secondary Data in Inter-Industry Analysis : A Study in the Economics of the Economic Models", ANNALS OF REGIONAL SCIENCE, Vol. 6 No.2 1972, 35-43.

5. Bradley, I. and Gander, J.P."Input-Output Multiplier : Some Theoretical Comments", JOURNAL OF REGIONAL SCIENCE, Vol. 9, 1969, 309-317.

6. Chenery, H.B and Watanabe,T."International Comparisons of the Structure of Production", ECONOMETRICA, Vol.26, No. 4, 1958, 487-521.

7. Czamanski, S. and Malizia, E.E."Applicability and Limitation in the Use of National Input-Output Tables for Regional Studies", PAPERS AND PROCEEDINGS OF THE REGIONAL SCIENCE ASSOCIATION, Vol. 23, 1969, 65-67.

8. Doeksen, G.A. and Little, C.H."Effect of Size of the Input-Output Model on the Results of an Impact Analysis", AGRICULTURAL ECONOMICS RESEARCH, Vol. 20, 1968, 134-138.

9. Harrigan,F., McGilvray,J. and McNicoll,I."Simulating the Structure of a Regional Economy", ENVIRONMENT AND PLANNING, Vol.12, 1980, 927-936.

10. Hazari,B.R."Empirical Identification of Key Sectors in the Indian Economy", THE REVIEW OF ECONOMICS AND STATISTICS, 1970, 301-305.

11. Hewings, G.J.D."Regional Input-Output Models Using National Data : The Structure of the West Midlands Economy", ANNALS OF REGIONAL SCIENCE, No. 4, 1969, 179-191.

12. Hewings, G.J.D."Regional Input-Output Models in the U.K. : Some Problems and Prospects for the Use of Non-Survey Techniques", REGIONAL STUDIES, Vol.5, 11-22.

13. Isard, W."Regional Commodity Balances and Interregional Commodity Flows", THE AMERICAN ECONOMIC REVIEW, XLIII, 1953, 167-180.

14. Javin, Emerson "An Inter-Industry Comparison of Regional and National Economic Structure", REGIONAL SCIENCE ASSOCIATION PAPERS, Vol. XXVI, 1971.

15. Lahiri, S."Efficient Investment and Growth Consistency in the Input-Output Frame : An Analytical Contribution", ECONOMETRICA. Vol, 45, No. 8, 1823-1835.

16. Lecomber, J.R.C. "A Critique of Methods of Updating, Adjusting and Projecting Matrices together with some New Proposals", PAPER PRESENTED TO NOVARICH CONFERENCE ON INPUT-OUTPUT ANALYSIS, 1971.

17. Leontief, W. "Quantitative Input-Output Relations in the Economic System of the United States", THE REVIEW OF ECONOMICS AND STATISTICS, Vol.XVIII, 1936, 105-125.

18. Leontief, W., Morgan, A. and Polenske, K., "The Economic Impact - Industrial and Regional - of an Arms Cut", THE REVIEW OF ECONOMICS AND STATISTICS, Vol. XLVII, 1965, 217-241.

19. Linsky, A.S. "Simulating Responses to Mailed Questionnaires : A Review" PUBLIC OPINION QUARTERLY, Vol. 39, 1975, 82-101.

20. McKay, D.I. "Industrial Structure and Regional Growth : A Methodological Problem", SCOTTISH JOURNAL OF POLITICAL ECONOMY, Vol. 15, 1968, 129-143.

21. Miernyk, W.H. "Long-Range Forecasting with a Regional Input-Output Model", WESTERN ECONOMIC JOURNAL, Vol. 6, 1968, 165-176.

22. Moore, F.T. and Petersen, J.W. "Regional Analysis : An Inter-Industry Model of Utah", THE REVIEW OF ECONOMICS AND STATISTICS, XXXVII, 1955, 368-383.

23. Morrison, W.I. and Smith, P. "Non-Survey Input-Output Techniques at the Small Area Level : An Evaluation", JOURNAL OF REGIONAL SCIENCE, Vol. 14, 1-14.

24. Moses, L. "Regional Economic Reaction Paths", AMERICAN ECONOMIC REVIEW, Vol. XLV, 1955, 150-153.

25. Pocock, D.C.D. "Dundee and its Region", in Johns S.J. DUNDEE AND DISTRICT, British Association for the Advancement of Science, Dundee, 1968.

26. Round, J. "Regional Input-Output Models in the U.K. : An Appraisal of Some Techniques", REGIONAL STUDIES, Vol. 6, 1972, 1-9.

27. Sandowall, A.D. "Constant Relationship Between Input-Output Multipliers", THE REVIEW OF ECONOMICS AND STATISTICS, Vol. 49, 1967, 599-600.

28. Schaffer, W.A. and Chu, K. "Non-Survey Techniques for Constructing Regional Inter-Industry Models". PAPERS AND PROCEEDINGS OF THE REGIONAL SCIENCE ASSOCIATION, Vol.23, 1969, 83-101.

29. Schaffer, W.A. and Chu, K. "Simulating Regional Inter-Industry Models for Western States", PAPERS OF THE FIRST PACIFIC REGIONAL SCIENCE CONFERENCE, TOKYO, 1971, 123-140.

30. Schaffer, W.A. "Estimating Regional Input-Output Coefficients", REVIEW OF REGIONAL STUDIES, Vol. II, No. 3, 1972, 57-71.

31. Schaffer, W.A. "On the Use of Input-Output Models for Regional Planning", STUDIES IN APPLIED REGIONAL SCIENCE, Vol.1, 1976.

32. Su, T.T., "A Note on Regional Input-Output Models", SOUTHERN ECONOMIC JOURNAL, Vol. 37, 1970, 325-327.

33. Tiebout, C.,"Techniques of Regional Forecasting", PROCEEDINGS OF THE SUMMER INSTITUTE ON REGIONAL ECONOMIC DEVELOPMENT MASSACHUSETTS, July-Aug. 1966.

34. Tiebout, C.M. "Input-Output and the Firm : A Technique for Using National and Regional Tables", THE REVIEW OF ECONOMICS AND STATISTICS, Vol. 49, 1967, 260-270.

35. Walderhang, A.T. "State Input-Output Tables Derived from National Data", PROCEEDINGS OF THE BUSINESS ECONOMICS STATISTICAL SECTION OF THE AMERICAN STATISTICAL ASSOCIATION, 1972.

36. Werner, Z.H. "Inter-Industry Relations of a Metropolitan Area", THE REVIEW OF ECONOMICS AND STATISTICS, Vol.XLI, No. 4, 360-369.

37. West,G. and Jensen,R.C."Some Effects of Errors in Coefficients on Input-Output Multipliers", PAPER PRESENTED TO THE INPUT-OUTPUT WORKSHOP OF THE SECOND MEETING OF THE AUSTRALIAN AND NEW ZEALAND SECTION OF THE REGIONAL SCIENCE ASSOCIATION, Sydney, 1977.

38. West, G. and Jensen, R.C. "Some Reflections on Input-Output Multipliers", THE ANNALS OF REGIONAL SCIENCE, Vol. XIV, No.2, 1980, 77-89.

E. SECONDARY SOURCES : BOOKS AND OTHER RESEARCH PAPERS

1. Begg, H.,Lythe, C. and McDonald, D. "Investment in Manufacturing Industry in Scotland, 1961-1971 : The Impact of Regional Policy, Occasional Paper No. 3, University of Dundee, 1975.

2. Blin, J. and Lohen, C. Technological Similarity and Aggregation in Input-Output System : A Cluster - Analytic Approach, Discussion Paper, No. 163, Northwestern University, Illinois, 1976.

3. Bulmer, Thomas,V., The Valuation of Transactions in Input-Output Tables, Discussion Paper, Fraser of Allander Institute, 1977.

4. Buxton, N.K. and Mackay, D.L. British Employment Statistics : A Guide to Sources and Methods, Basil Blackwell, Oxford, 1977.

5. Campbell, A.D. and Lyddon, W.D.C. Tayside : Potential for Development HMSO, 1970.

6. Lythe, C.,Begg, H. and Majumdhar, M. Expenditure in Scotland 1961-1973 Occasional Paper, No. 6, University of Dundee, 1977.

7. Gossling, W.T. (ed), Input-Output in the United Kingdom, Frank Cass & Co.Ltd,1970.

8. Harrigan, F.J and McNicoll, I.H. Superior Information and Non Survey Location Quotient Input-Output Simulation : Observation on Methods and Practice, Discussion Paper, University of Strathclyde, 1981.

9. Hewings, G.J.D. Aggregation of a Regional Input-Output Model and the Effect Upon Impact Analysis : A Comment S.E. Kent Regional Input-Output Study, Discussion Paper, No. 4, 1971.

10. Hirschman, A.O. The Strategy of Economic Development, New Haven & London, Yale University Press, 1958.

11. Isard, W. Methods of Regional Analysis, M.I.T. Press, Cambridge, Mass. 1960.

12. Isard, W. Location and Space Economy, M.I.T. Press, (4th edition) Cambridge, Mass. 1965.

13. Isard, W. and Langford, T.W. Regional Input-Output Study : Recollection Reflections and Diverse Notes on the Philadelphia Experience, M.I.T. Press, Cambridge, Mass. 1971.

14. Jensen, R.C., Mandeville, T.D. and Karunarathne, N.D. Regional Economic Planning : Generation of Regional Input-Output Analysis, Groom Helm Ltd, London, 1979.

15. Glasson, J. An Introduction to Regional Planning : Concepts, Theory and Practice, 2nd edition, Hutchinson & Co. 1978.

16. Kokat, R.G. The Economic Component of a Regional Socio-Economic Model, I.B.M. Technical Report, 1966.

17. Leontief, W. Input-Output Economics, Oxford University Press, New York, 1966.

18. Mandeville, T.D. Linking APMAA to Representative Programming Models for Australian Agriculture, Research Report, No. 8, University of New England, 1975.

19. McDowall, S. and Draper, P. Trade Adjustments and the British Jute Industry, Fraser of Allander Institute, Glasgow, 1978.

20. McGilvray, J.W. Linkages, Key Sectors and Development Strategy, Fraser of Allander Institute, Discussion Paper No. 4, 1977.

21. Miernyk, W.H. The Elements of Input-Output Analysis, Random House, New York, 1966.

22. Morrison, W.I. and Smith, P. Input-Output Methods in Urban and Regional Planning, A Practical Guide, PRAG Technical Paper, 1976.

23. Nevia, E.T., Roe, A.R. and Round, J.I. The Structure of the Welsh Economy, University of Wales Press, 1966.

24. O'Connor, R. and Henry, E.W. Input-Output and Regional Economics, Weidenfeld and Nicolson, 1975.

25. Erdos, P.L. Professional Mail Surveys, McGraw-Hill Book Company, U.S.A. 1970.

26. Bourque, P.J. et al., The Washington Economy : An Input-Output Study University of Washington, 1967.

27. Rasmussen, N.P. Studies in Inter-Sectoral Relations, Amsterdam, North Holland, 1956.

28. Richardson, H.W. Regional Economics : Location Theory, Weidenfeld and Nicolson, 1969.

29. Richardson, H.W. Input-Output and Regional Economics, Weidenfeld and Nicolson, 1972.

30. Schaffer, W A. and Chu, K Application of the Regional Input-Output Table Simulater : A Provisional Inter-Industry Model of Atlanta, Discussion Paper 6, Georgia Institute of Technology, 1968.

31. Smith P.and Morrison, W.I. Simulating the Urban Economy, Pion Lit, London, 1974.

32. Stone, R. Input-Output and National Accounts, OEEC, 1961.

33. Tilanus, C.B. Input-Output Experiments : The Netherlands 1948-1961 Rotterdam University Press, 1966.

F. THESES

1. Adamson, Y.K. Problems Concerning the Methods for Updating Input-Output Matrices, MSc Thesis, University of Birmingham, 1977.

2. Bulmer, Thomas, V. An Input-Output Planning Model for Costa-Rica, PhD Thesis, University of Oxford, 1976.

3. Cutbush, G.C. Input-Output Analysis and Regional Economic Planning, M.Ec Dissertation, University of New England, Armidale, 1973.

4. Harrop,B. A Study on the Determinants of Changes in Input-Output Coefficients, PhD Thesis, University of Bradford, 1978.

5. Howe, W.S. The Dundee Jute Industry : An Economic Organisation Study PhD Thesis, Dundee College of Technology, 1982.

6. McNicoll, I.H. Some Aspects of the Impact of Oil on the Shetland Economy, PhD Thesis, University of Stirling, 1978.

7. Omar, F.H. The Projection of Input-Output Coefficients with Application to the U.K. PhD Thesis, University of Nottingham, 1967.

G. OTHER PUBLICATIONS

1. Department of Applied Economics, University of Cambridge, Input-Output Relationships 1954-1966, A Programme for Growth No. 3, Chapman and Hall, London, 1963.

2. Dundee and Tayside Chamber of Commerce and Industry, Buyers Guide and Trade Directory 1980.

3. The Fraser of Allander Institute, The Scottish Council Research Institute Ltd; and IBM United Kingdom Scientific Centre, Input-Output Tables for Scotland 1973, Scottish Academic Press Ltd, 1978.

4. KBE(Key British Enterprise) 1981, Dun and Bradstreet, Directories Division, London, Vol. 1 and 2.

5. KOMPASS 19th Edition, Kompass Publishers Ltd, 1981.